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NUTRITION AND DIET THERAPY

by the same author

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THE STORY OF THE GROWTH OF NURSING

HYGIENE FOR NURSING STUDENTS

CLINICAL PROCEDURES AND THEIR BACKGROUND

The Author

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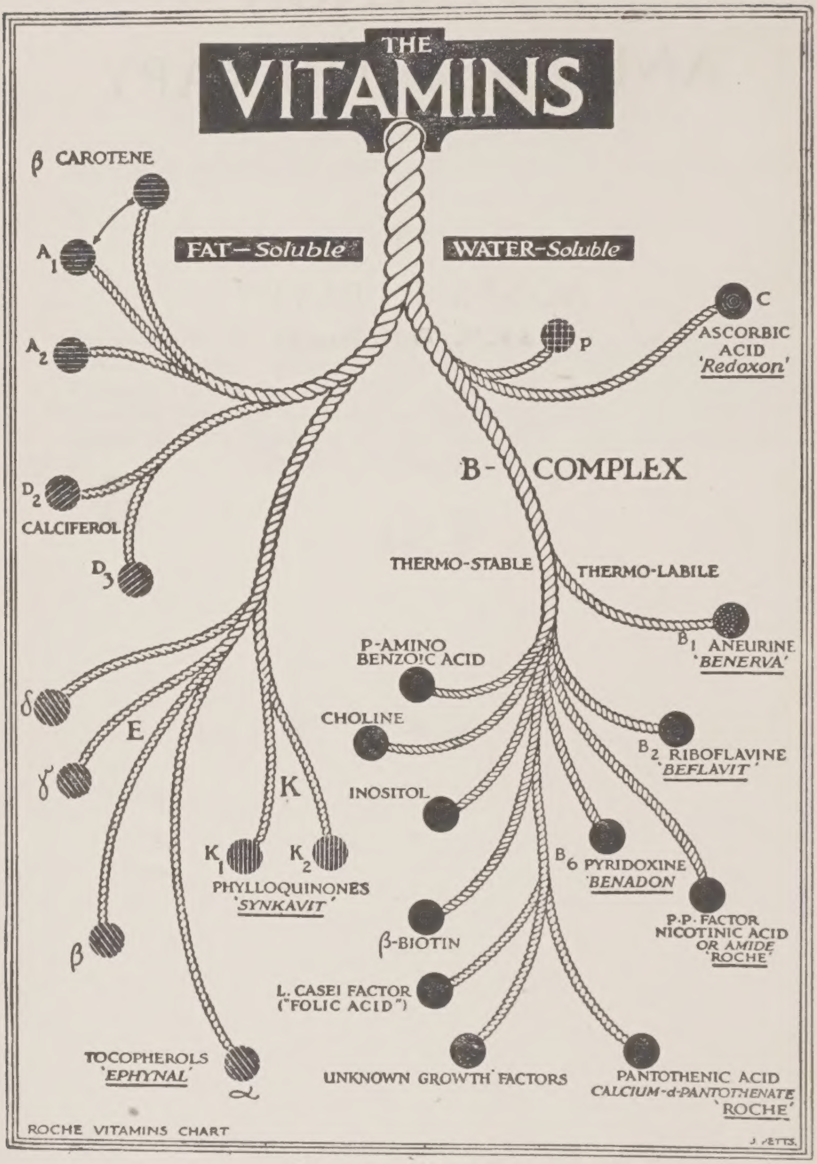

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UNRAVELLING THE VITAMINS

A diagrammatic representation of the progress made in the isolation and identification of the vitamins.

NUTRITION AND DIET THERAPY

by

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FABER AND FABER LIMITED
24 Russell Square
London

First published in Mcmxlviii
by Faber and Faber Limited
24 *Russell Square London, W.C.*1
Printed in Great Britain by
Western Printing Services Ltd., Bristol

PREFACE

The science of nutrition has made such rapid strides during the past decade or two that I felt there was a need for an up-to-date text-book for nurses that would deal not only with normal diet but would attempt to correlate nutritional science with normal physiology and with pathological changes in structure and function; and would show what part a carefully selected diet might play in restoring normality in each of the groups of conditions or diseases that appear to be influenced by the food intake. That has been my aim in writing this book.

I am acutely aware of the fact that, at the moment, national food shortages and restrictions hamper the dietitian in the choice and preparation of all special diets; but the impediments will surely become less in the comparatively near future. Even at the present time, so many 'priorities' are recognized and conceded that it seems unwise to be unduly influenced by difficulties in obtaining supplies when writing a book on nutrition, for the principles of nutritional science remain the same whatever the obstacles that exist with regard to their practice.

I regret that, in order to conform to the authorized economy standards regarding paper and printing, it is not possible to set out menus in a spacious and attractive manner; but that is a disadvantage that is shared by all writers at the present time.

AGNES E. PAVEY

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NORMAL NUTRITION

CHAPTER 1

INTRODUCTION

As an introduction to the subject-matter of this book it might be well to consider briefly the changes that have occurred within living memory in available knowledge of nutritional science and in the attitude of the majority of people towards food. In the early years of this century such 'deficiency' diseases as scurvy and rickets were rife, especially among the poorer people, and so also were poor physique and vague conditions of ill-health that were accepted as part of an inescapable human endowment. The discovery of the vitamins and the part they play in promoting and maintaining health, together with the realization of the importance of certain salts, brought about a rather sudden change in ideas regarding food requirements; but, although the science of nutrition was advancing by leaps and bounds, it was only during the years immediately preceding the recent world war that the new standard of food values was generally accepted or was applied practically to the arrangements of diets.

FOOD SUPPLIES IN THE FIRST WORLD WAR

In the early years of the war of 1914–18 there was no such control and rationing of food supplies as has prevailed since 1939. It appears to have been taken as a matter of course that Britain would keep the complete mastery of the seas. Difficulties with regard to supplies and distribution became acute by the end of 1916 and the new Government that came into office about that time promptly appointed Britain's first Food Controller, in the person of Lord Devonport, who took up the duties of his office on the 26th of December 1916. He was given wide authority, under the Defence of the Realm Act, to regulate the production of, and traffic in, food. Schemes of rationing of food were put into operation a year later, started first by local food committees empowered by the Food Control Committee under the Local Distribution Order of the 22nd of December 1917; a

uniform scheme for the whole of London and the Home Counties being introduced on the 25th of February 1918. Meat rationing was made compulsory throughout Britain in the following April, and a national scheme of rationing replaced the local schemes in July 1918, nearly four years from the commencement of the war and after three years of submarine attacks on our food supplies. This system continued to operate until 1920, and the Ministry of Food came to an end in March 1921. The machinery of food control, although organized so late in the war, did much to mitigate the ill-effects of food shortage and served as a useful example and precedent during the recent war. Protective substances that are necessary for the health of teeth and bones and that provide a safeguard against certain infections were, however, deficient in the dietaries of a great number of people; for emphasis was placed upon the amount rather than the kind of food that was taken, and insufficient consideration was given to the problem of providing a well-balanced dietary.

FOOD SUPPLIES IN THE SECOND WORLD WAR

When war again loomed upon the horizon much more was known about food requirements and consumption than in 1914, and the results of shortages of essential substances had been widely demonstrated and assessed. Preparations for stocking the nation's larder had been made, and on the outbreak of war in September 1939 a Ministry of Food was set up at once. This ministry became the sole importer of all essential foodstuffs that came from overseas for human consumption and for the feeding of livestock; and the sole purchaser of home-produced meat, sugar, and butter. Other foods were controlled by price orders; ration books were issued and consumers had to register with retailers for certain commodities by the end of the first month of the war. Rationing was extended to include meat in February 1940, and margarine, cooking fats, and tea in July of that year. In May 1941 cheese, jam, marmalade, and syrup came under rationing orders. Steps were taken, however, to avoid much of the ill-health that followed the food shortages and rationing of the first world war; for vitamins A and D have been added to all margarine sold in this country since rationing commenced, and vitamin B and a calcium salt have been added to flour since January 1941. These measures, together with priority allowances for pregnant

women, babies, children under five, certain classes of workers, and sick people who need a specialized dietary, have done much to avoid a repetition of the ill-effects of the inadequate diet of the previous war, and to raise the level of the nation's health and physique above that of the years between the two wars. Interest in dietaries has been aroused and knowledge of food values has been disseminated to a degree that could not have been possible during a period of peace in which there was an absence of restrictions. Moreover, the catering in hospitals, in British Restaurants, in canteens, and in hotels is now influenced by nutritional principles that were either not understood or were not taken into account in the years preceding 1939, and housewives take a more knowledgeable interest in providing a diet for their families that contains all the requirements for good development and the promotion and maintenance of health, in spite of wartime and post-war difficulties. Small wonder that in a modern nurse's training the science of nutrition is assuming a greater importance than ever before.

MODERN ATTITUDE TOWARDS HOSPITAL DIETS

FIRST MEMORANDUM ON HOSPITAL DIETS

Much has been said, and written, in recent years with regard to hospital diet, both for patients and staff. It formed the subject of a memorandum issued by King Edward's Fund for London in August 1943. This contained many comments and suggestions that were of interest to all nurses, both in relation to their own food and to that of their patients. It stated, in italics, that 'the food service should be regarded as one of the essential remedial services offered by the hospitals', and that it was 'essential to secure the constant interest and active co-operation of the medical profession'—a tacit acceptance of the fact that, hitherto, physicians and surgeons were not very interested in the vital question of their patients' food.

The memorandum advocated that every hospital should have a catering committee which should include the matron, the dietitian, and representatives of the medical staff, that patients' breakfasts should be served at a normal hour, such as 8 a.m., and that alternative dishes should be offered at all meals, as patients may dislike the chief dish on the menu. It strongly deprecated economizing on the wages of kitchen staff and suggested that a more experienced and

higher salaried personnel might easily effect a reduction in expenditure by better planning and by ensuring that food was not ruined during preparation or cooking. It stressed the importance of attractive methods of serving, and, although recognizing that this was mainly the responsibility of the ward sister, every student nurse should be trained to arrange trays so that each patient received a suitable and appetizing meal. In many hospitals individual trays were not, and are not, supplied for ward patients and the equipment of china, cutlery, glass, and linen may not be fully maintained. That statement was made several years ago when, although supplies were not easily obtainable, hospital stocks were not entirely exhausted. Since then the difficulties regarding supplies and replacements have increased.

Another important point made in the memorandum was that many patients were admitted to hospital suffering from chronic malnutrition, and that their stay in hospital should be regarded as a time for adjusting deficiencies. Certain foods ordered by the dietitian should be considered to be of sufficient importance to be purchased even if they were expensive; and the patient should be instructed in the best ways of securing adequate nourishment after his discharge from hospital.

Details of investigations carried out at three hospitals showed that at two of these the Calorie value of the food supplied to the nursing staff fell considerably below the required standard, whilst at the third, although the general level for both patients and staff was higher, it did not attain to the accepted level for satisfactory feeding. This memorandum served as a springboard for further investigation and development, for it was realized that the catering arrangements in many hospitals required some degree of adjustment before they could be considered satisfactory. During the following year many articles appeared in medical and nursing literature that attempted to assess the reasons for the low standard of catering and to suggest remedies.

JOURNALISTIC DISCUSSION

On the 6th of January 1944 the *Lancet* devoted its leading article to a criticism of hospital diet and, whilst recognizing the existing difficulties, urged that the medical profession should take a stand

for the provision of better food in hospitals, concluding, 'Good food is as necessary to the recovery of health as good nursing, surgery, and medicine, and it is folly to pretend that it is beyond the power of our profession to change the reproach. It has been created by our indifference and idleness and it must be removed by a bit of hard work'.

Following this editorial there appeared a series of articles on the subject, the first of which was entitled 'What is wrong with Hospital Diet?' These articles traced the beginning of poor catering to the charitable origin of hospitals, with their custom of expecting the patients' friends to supply the greater part of the required food. They ascribed the existing shortcomings to indifferent buying, bad storage accommodation, inadequate kitchen staff and equipment, poor cooking, bad transport from the kitchen, unskilful carving, and 'failure to place the catering in the hands of a single experienced officer with sufficient influence to stake out a fair claim on the hospital income', for 'while the buying of food is the responsibility of one officer, the cooking the responsibility of another, and the distribution of a third, it is not possible to achieve a high standard throughout hospital feeding'. Whether the caterer was to work under the secretary, the steward, or the matron was stated to be immaterial and would depend upon the organization of the hospital; but having obtained a caterer the hospital should see that the storerooms, kitchens, service facilities, and dining-rooms are satisfactory, and must be prepared to have the kitchen open all day, so that all food can be freshly cooked and the necessity for cooking to be done in the ward kitchen is obviated. A part of the kitchen—or a smaller one—should be open at night for the purpose of cooking the food required by the night staff, which should, if possible, be served in a dining-room away from the wards.

The committee of King Edward's Fund for London continued its investigations and found that a large proportion of the complaints received were of 'the dreary monotony' of the menus. Meanwhile, hospital authorities became more interested in the subject of food, partly because they were awakening to the defects of catering within their walls and partly owing to the difficulties that arose, as the war progressed, in obtaining the usual supplies, and the acute shortage of available labour for the preparation, cooking, and serving of food. In many hospitals a dietetic department had become an integral part

of the organization, but its activities were often limited to the arrangement of special diets and they seldom included routine diets, either of the patients or the staff. Various educational bodies established somewhat comprehensive courses for the training of dietitians. For example, the course at the Royal College of Nursing covers a period of eighteen months whole-time study for women who are already experienced qualified nurses; which is an indication of the scope of the knowledge that should be acquired by one who aspires to hold a position involving the responsibility of feeding the sick and those who minister to them.

SECOND MEMORANDUM ON HOSPITAL DIETS

In July 1945 the committee of King Edward's Hospital Fund for London issued, 'for the consideration of hospitals', its second memorandum, and this is one of the most constructive memoranda on the subject of diet in hospital that has ever emanated from this or any other source. In the introductory section it states that 'experience gained during the past eighteen months from a close study of conditions in hospitals has brought the picture into sharper relief'. It stresses the view that good feeding must be regarded as a primary and essential part of all treatment and that patients should leave the wards of a hospital impressed, not only by the quality of the food they have received during their stay, but by all they have learned there of the importance of diet in the maintenance of health. It recognizes the fact that many hospital kitchens were originally planned and staffed to provide only one cooked meal a day, whereas they may now be serving three cooked meals daily for both patients and staff. Criticisms of hospital diets referred chiefly to the monotony of meals and poor standards of cooking, shown particularly by overcooked potatoes and vegetables, tasteless gravies, unappetizing boiled fish, and an unimaginative choice of puddings and sweets. Hospitals differ from other catering establishments in that, in the latter, the quality of the meals served is commonly maintained by the reaction of the consumer who pays for them, and any falling off of the quality of the food is quickly reflected in the receipts; whereas this stimulus to good catering, cooking, and serving does not operate in hospitals. The memorandum recognized that in order to raise the standard of hospital dietaries more money would be needed than was then being

spent on food, kitchen equipment, and staff; and the need for skilful economy at all stages of the catering chain was imperative in order that the extra expenditure should be limited as far as was consistent with the establishment and maintenance of a satisfactory standard.

THE SCOPE OF THE MEMORANDUM

Having stated the main problems, the memorandum devoted eight sections to practical advice of a detailed kind on organization, staffing, buying, record-keeping and storing, menu-planning, service and waste, cleanliness in the kitchen, and salads and vegetables—with special reference to the conserving of vitamin C. Six appendices dealt respectively with suggested menus, examples of recipes, duties of visiting dietitians, tables of standard requirements, tables of food values, and specimen stock sheets.

Many of the valuable suggestions made were difficult to put into operation at that time. The main problem was efficient staffing of kitchens and wards, for domestic labour in hospitals was such that temporary daily women workers, in inadequate numbers, formed the majority of the kitchen staff, and in wards it often fell to the lot of experienced sisters not only to serve meals but also to prepare equipment and wash up all the china and utensils that had been used; whilst the student nurses dealt with the domestic work in the wards. This problem is still with us, but with the final release of women from war industries and from the Services its solution may be in sight, and then the implementation of the suggestions given in the memorandum will be free from one obstacle that has been increasingly present in recent years. There is reason to hope that the relaxation of restrictions upon the purchase of equipment will keep pace with improvements in staffing; but much of the responsibility for developing, in the student nurse, a true sense of the therapeutic importance of food lies with the teaching staff, both in the classrooms and the wards.

It is encouraging to note the emphasis that is now placed upon the psychological effect of an attractively prepared tray, with a judicious use of colour in planning and serving meals. Hitherto the therapeutic value of a meal that *looks* good to eat, presented upon a tray that is arranged with artistry, has for the most part been given insufficient attention in the general wards. The student nurse learns, in the early part of her training, how to make a tray attractive with clean linen,

charming china, a few flowers, and an artistic menu card, but she finds neither the time nor the equipment that would enable her to put her knowledge and experience into practice. With regard to the meals served to private patients, a few hospitals *do* achieve the standard taught in the classrooms, which shows that it is a possible standard.

CHAPTER 2

THE NORMAL DIET

PROTEINS, CARBOHYDRATES, AND FATS

Foods are organic and, to a lesser extent, inorganic substances which are taken into the body and, after undergoing the various processes of digestion and absorption, are capable of renewing the tissues of the body and of supplying the materials necessary for growth, for the maintenance of body temperature, and the promotion of correct metabolism. The organic substances are considered as nitrogenous and non-nitrogenous foods. The former are the proteins and the latter include carbohydrates and fats. The inorganic substances are mainly water and mineral salts. Water forms about 80 per cent of all solid food in addition to that taken in liquid form; whilst mineral salts are of various kinds and are necessary for the correct functioning of many of the tissues of the body.

The science of nutrition deals with the needs of the body for specific substances in adequate amounts, and with the pathological effects of a failure to meet these needs. Such failure does not always infer that a required substance was absent from, or deficient in, the diet; for there may be some failure of digestion or absorption, or an inability to utilize a substance that is essential to health. The term *undernutrition* is usually taken to mean that insufficient food is taken to maintain normal weight and energy; whereas the term *malnutrition* denotes a condition in which the fault does not lie in the taking of an insufficient amount of food, but in the taking of a diet deficient in certain substances that are essential to health. Persons suffering from malnutrition are not infrequently overweight, as may be seen in the fat baby with rickets.

An estimation of food requirements is based upon a knowledge of the chemistry of the tissues and a classification of foods according to their chemical composition. The planning of meals must have regard

to both the choice and the amount of foods so that they will be suitable for the widely varying conditions of life in health, and will have a therapeutic value in disease. The amount and character of the food ingested is responsible for controlling the acid/base balance of the body, and this is an aspect of diet that assumes importance in certain conditions. Most animal foods leave an acid residue after their utilization, whilst many fruits and vegetables yield an alkaline residue, and this should be sufficient to neutralize any excess of acid. An excess of base-forming foods appears to help in building up an alkaline reserve, which seems to improve the body's resistance to infection and make for better health than occurs when acid-forming foods predominate in the diet. The satisfactory nutrition of the individual depends, however, not only on the quantity and quality of each type of food that is consumed but is also influenced by such factors as peace of mind, absence of distracting noise, attractive preparation of the food itself, and surroundings that give æsthetic pleasure. In many conditions of ill-health the application of nutritional science can do much to aid recovery.

DIETARY CONSTITUENTS

A satisfactory diet must contain seven essential constituents. These are:

(1) *Proteins*—for the growth and repair of tissues.

(2) *Carbohydrates*—to supply heat and energy, and also for storage.

(3) *Fats*—to conserve the heat of the body and to be stored as fuel.

(4) *Vitamins*—substances which protect the body against certain diseases and bacterial invasions, and are necessary for the utilization of calcium.

(5) *Mineral salts*—for the hardening of bones and teeth, and for the efficient functioning of many kinds of tissue cells.

(6) *Water*—to maintain the correct density of all body fluids.

(7) *Roughage*—to stimulate peristaltic action and so assist in the elimination of waste products from the large intestine.

PROTEINS

Chemically, proteins contain the elements carbon, hydrogen, oxygen, and nitrogen with small amounts of sulphur and phosphorus. In fact, they are the chief food sources of nitrogen and sulphur, whilst the proteins of milk and eggs form valuable sources of phosphorus. Proteins are very complicated in their molecular structure, for the elements are formed into colloid compounds of various amino acids which are linked to each other in the molecule. In its unaltered form protein cannot be absorbed in the intestines, so that it needs to be broken down through several stages of digestion which cause the linkages of the various amino acids to give way and thus set each free before it can be absorbed by the blood capillaries in the villi of the small intestine and be utilized in the building up of the tissues of the body. It has been shown that, in some people, certain unaltered proteins can be absorbed, probably from the stomach, and that this may account for the allergic reactions that sometimes occur. The body appears to be incapable of storing substances containing nitrogen, so that any amino acids not needed for the building or the upkeep of tissues are subjected, in the liver, to a process of *deaminization* by means of which their nitrogen is removed and, together with the hydrogen obtained from the desaturation of fats, is built up into urea and ammonium salts, which are excreted by the kidneys. The carbon, hydrogen, and oxygen that remain after deaminization are either combusted as carbohydrate or stored as fat. It is, therefore, uneconomic to take more proteins than are necessary and it places an additional burden upon the liver and the kidneys.

Recent research has resulted in the isolation of twenty-one different amino acids, ten of which are considered to be indispensable for the maintenance of healthy human tissues. These are tryptophane, lysine, histidine, phenylalanine, leucine, isoleucine, threonine, methionine, arginine, and valine. Methionine can, to a certain extent, be replaced by one of the non-essential amino acids—cystine—whilst arginine can be synthesized in the body, but not sufficiently rapidly to meet the needs of normal growth.

Food proteins are of two main classes—animal, or class A, proteins, which contain all the indispensable amino acids in the proportions necessary for the growth and repair of human tissues; and vegetable, or class B, proteins, which have deficient quantities

of one or more of the indispensable amino acids; and this necessitates the taking of larger amounts of the protein than would be required if the proportions of amino acids were correct for the needs of the body.

Examples of class A proteins are:

Myosin—the chief constituent of lean meat and fish.

Albumen—the white of egg, the lactalbumen of milk, and the serum albumen of blood.

Caseinogen—the curd of milk and the main substance of cheese.

Vitellin and Globulin—found chiefly in egg-yolk.

The proteins of animal origin are always associated with a certain amount of fat and fat-soluble vitamins, together with extractives that stimulate the flow of digestive juices, and some mineral salts.

Examples of class B proteins are:

Gluten—in cereals, wheat, and bread.

Legumen—in peas, beans, and lentils.

Nuclein—in liver and kidneys. Although of animal origin, nuclein is not a class A protein.

Vegetable protein is always associated with carbohydrate, and generally with mineral substances, and with some of the water-soluble vitamins. It is rather less digestible than animal protein, because it is contained within a cellulose 'wall'. Gelatine is a protein, but it lacks three of the essential amino acids. It is therefore known as an incomplete protein, and so also is zein, the protein of maize.

The amount of protein needed by growing children is 3 grammes daily for each kilogramme of body weight; and at least half, and if possible two-thirds, of this should of be animal origin. For adults, 1 gramme daily for each kilogramme of body weight is regarded as being sufficient, at least one-third of this being animal protein.

The effects of starving the body of protein are stunted growth, lowered stamina and efficiency, anæmia, functional nervous conditions, lessened reproductory power, and earlier senility. Over-eating of protein may result in a stimulation of metabolism that interferes with growth, intestinal putrefaction, unnecessary strain on the liver and kidneys, and a lowering of the body's alkaline reserve which may lessen vigour and increase susceptibility to infection.

The amount of protein that is present in some common foods has been estimated as follows:

ANIMAL FOODS

	Grammes per ounce
Lean roast beef	7·5
Stewed tripe	7·5
Cheese	7·0
Steamed cod	5·0
Cooked mutton	4·0
Egg, taking white and yolk	3·5
Milk	1·0

VEGETABLE FOODS

	Grammes per ounce
National bread	2·5
White bread	2·2
Legumes	1·8
Boiled potatoes	0·5
Root and green vegetables	0·2 (the quantity being variable)

NUTS

	Grammes per ounce
Almonds	5·0
Walnuts	4·2
Brazil nuts	4·0
Hazel nuts	3·0
Chestnuts	0·8

Peanuts contain 7 grammes of protein per ounce but this is of very poor quality.

CARBOHYDRATES

Carbohydrates are relatively simple compounds of carbon, hydrogen, and oxygen. Their main function in the body is to serve as a fuel for the supply of muscular energy; but a small amount is utilized to play a vital part in cell construction, in nervous function, and in the production of immunity. If taken in excess, some is converted into fat and is stored in the superficial tissues of the body.

Carbohydrates are derived mainly from vegetable sources, and they include all the starches and sugars. The starches have the more

complex molecule and are known as polysaccharides. The sugars are of two classes—the complex sugars or disaccharides, and the simple sugars or monosaccharides. The latter need no digestion, but both disaccharides and polysaccharides must be converted by the processes of digestion into monosaccharides before they can be absorbed and be utilized by the body. The chief sources of carbohydrates are:

Starches—found in wheat, potatoes, rice, barley, oatmeal, cornflour, tapioca, peas, beans, and lentils.

Complex sugars—in the form of *sucrose* in cane sugar and beet sugar, as *maltose* or malt sugar, found in malted barley and in sprouting grains, and as *lactose* or milk sugar, which is practically the only carbohydrate of animal origin.

Simple sugars—as glucose, fructose, and galactose. The first two are present in the juices of plants, in fruits, and in honey. Galactose is a constituent of milk sugar.

An animal starch called glycogen is present in liver, where it is normally stored after absorption from the digestive tract, and in some shellfish, particularly in oysters.

All carbohydrates, by digestion, are broken down into glucose and as such are absorbed by blood capillaries in the villi of the small intestine and are carried to the liver in the portal circulation. If not required for immediate use, it is changed into an insoluble glycogen and stored in the liver and the muscles. When needed, it is reconverted into glucose and is transported by the blood to the muscles where it is oxidized to provide energy, and to secreting glands where it stimulates their chemical functions. The glycogen that is stored in the muscles can be mobilized when strenuous muscular exercise is necessary and when the amount of glucose in the blood is lowered. Of all the tissues of the body, those of the central nervous system are the most dependent upon glucose derived slowly but continuously from the blood, for nervous tissue has little glycogen and it is doubtful whether even that small amount can be mobilized for use in an emergency. The dramatically rapid development of coma in hypoglycæmia is evidence of this.

Carbohydrate is often spoken of as a 'protein sparer', for although proteins can be utilized to provide energy if they are first denitrified by the liver, this is an extravagant process. It will happen, however, if a diet is taken that contains a great deal of protein and only a small amount of carbohydrate. In this country the average diet con-

tains from three to five times as much carbohydrate as protein; for carbohydrates are often the cheapest of foods and most of them can be readily produced. This is particularly true of potatoes and cereals. For these reasons they are apt to form too large a proportion of the diet of the very poor. Their greatest defects are that they are lacking in vitamins and in mineral salts and they are too bulky to be satisfactory as the only sources of energy in the body.

Sugar, as obtained from the grocer, is a pure carbohydrate. It contains practically no mineral salts and no vitamins. Bread contains, in addition to carbohydrate, a little protein, some vitamin B_1 and some mineral salts, particularly potassium, phosphorus, sulphur, and magnesium, all of which are present in wheat; but sodium is also present because salt is added in the making of bread.

It is now known that the vitamin B complex plays an essential part in carbohydrate metabolism and that the need for this group of vitamins increases as the carbohydrate intake is raised. In natural foodstuffs, such as whole grain and other plant substances, there is present an ample quantity of the B complex vitamins, but the industrial processing of foods led to errors of nutrition as a result of the removal of these vitamins. The diseases that developed—beri-beri and pellagra—were attributed solely to vitamin deficiency. We now recognize that, although this deficiency is the primary cause, the reason is to be found to a great extent in the defective carbohydrate metabolism. Two mineral salts—magnesium and phosphorus—are also essential for the utilization of carbohydrate, but these too are normally present in cereals and carbohydrate plant substances.

The carbohydrate content of one pound of each of the following common articles of food has been estimated as:

	Grammes
Bread, made from National flour	200
Sugar	450
Rice, boiled in water	130
Potatoes, boiled	100
Peas, beans, or lentils, boiled	80
Parsnips, boiled	50
Carrots	20
Chocolate, plain sweetened	280
,, milk	250
,, bitter	85

FATS

Fats are composed of carbon, hydrogen, and oxygen; the proportion of oxygen being less than that of a carbohydrate. Some fat-like substances, such as lecithin, which is present in egg-yolk, in brain and in other nervous tissue, contain phosphorus and nitrogen in addition. On account of their relatively high percentage of carbon, fats produce more heat as a result of combustion than do carbohydrates, but they require some carbohydrate for the process to be complete. If they are incompletely combusted, fats produce intermediate substances known as ketones. These are acid bodies and if not excreted they interfere with the acid/base balance, with serious effects to the body as a whole. Apart from their use as a source of energy, it is now known that fats enter into many vital processes, such as the construction of cell walls and of nervous tissue. The small amount of phosphorized fat that is present in human milk is essential for the myelination of nerve fibres in the infant.

The chief sources of animal fats are butter, cream, the fat of meat and bacon, and to a lesser extent, cheese and egg-yolk. Some fish, particularly herrings, sardines, and salmon, contain a certain amount of fat. Most of these animal fats contain vitamins A and D, which render them more valuable in a dietary than vegetable fats, in which these vitamins are absent. Vegetable fats are found as olive and nut oils, cocoa, chocolate, margarine, and the frying oil that is used commercially; but all margarine that has been on sale in this country since 1939 has vitamins A and D added to it, so that it is the equivalent of summer butter in nutritive value unless rancidity occurs, for in this condition vitamin A is rapidly destroyed.

Fats are our only source of essential fatty acids. They are also desirable in a diet because they have more than double the calorific value of either proteins or carbohydrates, so that they form a relatively less bulky source of energy. They therefore make it possible to satisfy hunger, even when heavy manual work is being performed in inclement weather, without over-distending the stomach. Hunger appears to be better-satisfied when fat is taken in the diet, and many dishes can be made more appetizing by its use. When, however, food becomes coated with fat during the process of frying, it is rendered difficult to digest because the protein and carbohydrate cannot be subjected to enzyme action until the fatty coating is digested, and this

does not occur until the food reaches the intestine. The delay may favour putrefaction of the protein or fermentation of the carbohydrate in the intestine. Some fats have a definitely laxative action, but naturally in this case less fat is absorbed.

CHAPTER 3

THE NORMAL DIET (*continued*)

MINERAL SALTS AND THE ACID/BASE EQUILIBRIUM

Minerals are not required for the production of energy but small quantities of various mineral elements are necessary for the regulation of many of the physiological processes within the body. The hardening of bones and teeth in childhood and the healthy maintenance of these tissues in adults demand a good supply of minerals. Those that form part of the different tissues require to be finely balanced in order that function shall be efficient. Upon this balance depends such important functions as the rhythmic beating of the heart, the ready response of nerves and muscles to stimuli, the correct osmosis between cells and intercellular fluids, and the maintenance of a faintly alkaline reaction in all body fluids which prevents the development of a condition called acidosis.

The mineral elements that are present in food or in the body may be in the form either of simple salts or of complex organic compounds, and in both cases they remain in the ash when the organic or combustible substances in which they are contained is burned; so that they are often referred to as the ash constituents of food.

There are only four mineral elements of which there is danger of a deficient supply, except in serious cases of starvation. These are calcium, phosphorus, iron, and iodine. If these are present in adequate amounts it is found that all the other minerals of which the body has need will be furnished also, for they are present in the same foods. They include sodium, potassium, copper, sulphur, and magnesium.

Calcium, or lime salts. These are necessary for the hardening of bones and teeth, the coagulation of the blood, the normal working of the heart, and the prevention of excessive excitability in nerve cells. Calcium is present in an organic form in milk, cheese, eggs, green vegetables, fruit, cereals, sprats, sardines, almonds, and Brazil nuts,

and as inorganic salts in ordinary drinking water. Only about 30 per cent of dietary calcium is absorbed by the small intestine, the remainder being excreted in the fæces. Small amounts of blood calcium are excreted by the kidneys. A low level of blood calcium may give rise to muscle soreness and spasm, tingling of the extremities, and neuritis. Such symptoms often occur towards the latter weeks of pregnancy, when the level of plasma calcium normally tends to be low. The muscle cramps that follow diarrhœa and marked diuresis are thought to be due to excess calcium loss by the bowel and the kidneys.

It has not hitherto been found possible to state the amount of dietary calcium required by man, for this depends upon variable factors, such as the degree to which the calcium in food is available and can be absorbed, and the degree to which the body can make use of available calcium. Few foods give up their calcium to man to a greater extent than does milk, for experiments have shown that whereas the absorption of milk calcium varies between 24 and 80 per cent, that of carrots, lettuce, and runner beans may be absorbed only to the extent of 13 to 60 per cent. Thus in discussing food values reference is often made to the *available* calcium content of the food in question, as distinct from the actual amount present.

The metabolism of calcium is regulated by the secretion of the parathyroid glands and by vitamin D. In young children a failure of calcium metabolism leads to rickets, malformed or decaying teeth, and stunted growth. If parathormone is deficient at any age the calcium level of the plasma falls but the phosphorus level rises. This hormone is thought to produce its effects through the excretion rather than the absorption of the two minerals in question; but it is the chief factor responsible for maintaining the calcium/phosphorus balance.

Phosphorus. This mineral plays the most varied role of all the nutrients required for growth or maintenance of the animal body. It is required by all types of tissues, especially for the nuclei of cells, for the lecithin of nerve tissue, and for muscular contraction. Good food sources of phosphorus are milk, cheese, the germ of wheat, oatmeal, beans, and lentils. Some table salt contains small amounts of calcium and magnesium phosphates. Practically, a deficiency of phosphorus in the diet is unlikely to occur since most naturally produced foods contain ample supplies, and as all foods that are

rich in calcium are also rich in phosphorus it is assumed that a diet that is adequate regarding the former will supply all that is needed of the latter.

A large part of the phosphorus in the body is present in the bones, as calcium phosphate, where it exists in a relatively inert form. Like calcium, only a proportion of dietary phosphorus is absorbed, the remainder being excreted by the bowel. Excretion of phosphates by the kidneys takes place slowly, but it is increased as a result of vigorous muscular exercise, during periods of starvation, and after the administration of such diuretics as sodium sulphate, sodium nitrate, calcium chloride, and ammonium chloride; but not when the diuresis follows the ingestion of large quantities of water. Urinary excretion of phosphorus is lowered during pregnancy because of the demands of the fœtus for this mineral.

Iron. This element is essential for the formation of hæmoglobin in the red corpuscles of the blood. The function of hæmoglobin is to combine with oxygen in the lungs and transport it to the tissues; and the oxygen-carrying capacity of the blood depends upon the hæmoglobin content of its red corpuscles. A deficiency of iron results either in the formation of fewer red blood-cells or of cells which contain less than the normal amount of hæmoglobin, the ensuing condition being known as anæmia. Iron is better absorbed when the diet is rich in calcium, but it would appear that the permeability of the intestine for iron is influenced by the reserves in the body. If iron is deficient its absorption is increased, whereas when the body contains adequate amounts of iron only traces of this mineral are absorbed however large the intake. Having been absorbed, iron is not excreted in appreciable amounts nor is it destroyed in the body. When the red cells are disintegrated their iron is stored, either in the liver or the spleen, and is used over and over again. Infants and young children need to augment the iron content of their bodies in accordance with their increasing size and increasing volume of blood. Women must replace the iron lost to the body as a result of menstruation and childbirth, and during pregnancy in order that the developing child may be supplied. Any condition in either sex that is associated with hæmorrhage, whether acute or chronic, leads to a depletion of iron, and thus to anæmia unless the reserves are made up.

Due to the fact that iron exists in two forms—organic and inorganic—the total iron content of foods is not always a true indication of the

amount that is *available* for absorption and synthesis into hæmoglobin, for this depends upon its ionizable nature. Iron that is combined with pyrrole derivatives is not available, and any discussion of the iron content of various foodstuffs must take this factor into consideration. Red meats, for example, are rich in iron, but relatively little of it is available. In the prevention and treatment of anæmia, however, although the administration of iron is important, it is equally important to consider the protein, or globin, part of hæmoglobin and, therefore, the diet should contain an adequate amount of first-class protein, such as can be supplied by red meats.

The most efficient iron-containing foods are liver, egg-yolk, nuts, brown bread, dried fruits, especially figs and apricots, cocoa, chocolate, lentils, spinach, watercress, and all fruits and green vegetables that are rich in chlorophyll. Iron in drinking water and in some medicinal preparations is in an inorganic form, and therefore needs to undergo changes before it can be utilized in the body. Milk is deficient in iron, but during intra-uterine life iron is stored in the liver of the developing child in sufficient quantities to supply its needs until a more varied diet can be taken. Moreover, there is a higher concentration of hæmoglobin, and therefore of iron, in a new-born baby's blood than in that of an older child or an adult. In spite of these two avenues of storage the supply often becomes exhausted before the baby is able to obtain its own iron from food, and this is one reason why babies may become pale and look rather anæmic between the ages of six and eight months.

Since an increasing number of people have become regular blood donors in the past few years, giving half to one pint of blood at intervals of a few months, the necessity for the replacement of iron has received special consideration. Each 100 cubic centimetres of normal blood contains approximately 50 milligrammes of iron; so that the giving of a pint of blood involves the loss of 250 milligrammes of iron, which is roughly equivalent to the amount lost by menstruation in a year. This iron must be replaced if anæmia is to be avoided, and, as it is difficult to arrange a diet that would contain the necessary amount, the food intake may be supplemented by a medicinal preparation of iron salts. The donor then suffers no loss of vitality as a result of the venesection.

Iodine. As far as is generally known, the main use of iodine in the body is related to the secretion of the thyroid gland—thyroxin. Very

small quantities are needed, but if these are not present a condition of goitre occurs and the deficiency of thyroxin seriously interferes with the metabolic processes of the body. It has recently been found that other endocrine glands, particularly the suprarenals and the ovaries, contain minute amounts of iodine. The testicle, however, contains less than one-tenth the amount normally found in the ovary. As iodine comes originally from the seas, the main sources of dietary iodine are sea foods, especially shellfish. But the air near the seas contains small amounts which may be inhaled, and iodine is also present in drinking water. Lack of iodine occurs chiefly in inland regions such as Switzerland and parts of the United States, where it may lead to simple goitre amongst girls at puberty, recurring during pregnancy. If not treated in time—with minute quantities of iodine—children may be born cretins and will not develop either physically or mentally. On the advice of Public Health authorities, iodine is usually added to all table salt that is sold in districts where endemic goitre is liable to occur.

Sodium and potassium. These two minerals are present in all tissues and organs, the ratio of potassium being the higher; but in an ordinary mixed diet there is more sodium than potassium because sodium chloride, or common salt, is added either during the processes of preparation and cooking or at the time of consumption. Sodium is needed by every cell and tissue of the body, in order to assist in the production of glandular secretions and to maintain the slight alkalinity of the blood. Potassium is needed for cell-building, especially of red blood-cells, and for muscle contraction. Many so-called 'laxative' foods owe their laxative qualities to the potassium they contain. The chlorine taken in sodium chloride is needed by many tissues, and especially for the production of hydrochloric acid in the gastric juice.

Copper. This is needed by the red blood-cells and it is believed to assist in the utilization of iron and therefore in the prevention and cure of iron-deficiency anæmia; and it is probably important in the physiology of the central nervous system. It is present in liver, fish, poultry, whole-grain cereals, nuts, cocoa, mushrooms, legumes, artichokes, and leafy vegetables. The widespread use of copper-containing sprays on growing fruits and vegetables or the addition of copper sulphate to the soil adds to the copper content of the resulting produce. Copper deficiency is most likely to develop during

infancy and can be prevented by the introduction of supplementary feedings. The copper content of human milk is probably higher than that of cow's milk, but that of both is low.

Sulphur. This is also needed for cell-building, and for the healthy condition of epidermal tissues, especially hair and nails. It is derived chiefly from two amino-acids in the food—cystine and methionine. These are contained in eggs and vegetables, especially onions. The intake of sulphur presents no problem in nutrition provided that an adequate intake of protein is maintained.

Magnesium. Magnesium is an essential mineral in the bones and teeth, and it is stated to be important in the metabolism of phosphorus and of carbohydrate. There can never be a deficiency of magnesium when a mixed diet is taken, for it is present in minute amounts in all flesh foods, in vegetables, particularly the pulses, and in many nuts. It appears that only the quantity needed by the body is absorbed from the alimentary tract although a slight excess may be absorbed with difficulty. A very small amount is excreted in the urine and this is quite easily made up by the food content. No disorders due to deficiency of magnesium have been described.

THE ACID/BASE EQUILIBRIUM

In order to maintain optimum vitality it appears that acids and bases in the body must be balanced. Many metabolic processes produce acids and many foods are acid-forming. Other foods yield an alkaline residue which is able to neutralize excess acids, and the tissues are thus enabled to build up a reserve store of alkalis. An alkali reserve appears to render the body more vigorous and better able to withstand bacterial invasion than when acids predominate.

The principal basic elements are calcium, magnesium, sodium, and potassium. They influence many properties and functions of living cells, including their water content, osmotic pressure, permeability, irritability, and general metabolism. When foods containing sulphur and phosphorus are oxidized in the body they give rise to acids, excess of both acids and bases being excreted in the urine. Sulphur and phosphorus are constituents of protein foods, so that on a high-protein diet the urine will be acid whilst on a vegetarian diet it will be alkaline. The question as to whether the acid and basic foods should be balanced in a diet has received a good deal of attention;

but it appears that only in abnormal circumstances should this be necessary. An excess of acids augments the excretion of urinary calcium whilst an excess of alkali increases the excretion of urinary phosphorus, although calcium and phosphorus do not of themselves appear to play an important part in the regulation of the acid/base equilibrium.

The combustion of carbohydrates and fats gives rise to carbon dioxide (carbonic acid gas) and this is eliminated by the lungs.

Effects of acid/base balance on digestion. The various enzymes that are responsible for the chemical processes of digestion require different degrees of acidity or alkalinity in order to carry out their functions efficiently. Some are inactivated or destroyed in the wrong medium. The ptyalin of the saliva—sometimes called the salivary amylase—which hydrolyses cooked starches into maltose, is destroyed by the free hydrochloric acid in the stomach but, depending upon the size and character of the meal, some salivary digestion continues in the stomach in the interior of the mass of food. When the acid chyme enters the duodenum it is neutralized and the undigested starch is then acted upon by the pancreatic amylase, after which the intestinal enzymes hydrolyse the maltose into glucose which is absorbed. If the conditions are abnormal, or the dietary intake of starches and sugars has been excessive, so that their digestion is not completed in the small intestine, bacterial action upon the residue results, producing gases which cause distension and irritating acid substances that inflame the intestinal mucosa.

Insoluble protein substances can be converted into soluble peptones only after they have been changed into metaproteins by the acid of the gastric juice. They then pass into the duodenum and, when the acidity of the peptones and of any proteins that have escaped gastric digestion is neutralized, the pancreatic trypsin and the intestinal erepsin complete their digestion into amino-acids; and both these enzymes need an alkaline medium for their optimum function. Undigested proteins undergo putrefaction in the alimentary tract, leading to diarrhœa and toxic absorption.

With regard to fat digestion, some lipase is present in the gastric juice but its action is completely inhibited by hyperacidity and it is slowed down even by normal acidity. When fat reaches the duodenum its digestion is accomplished mainly by the pancreatic lipase, acting in an alkaline medium.

An inadequate salt intake or the loss of electrolytes by vomiting, diarrhœa, prolonged gastric suction or a high intestinal fistula are factors that cause an alteration in the acid/base equilibrium. In vomiting and gastric suction acids are lost to the body. The kidneys then retain chloride, the essential substance for the production of hydrochloric acid, and excrete sodium. When basic elements are lost to excess, as in diarrhœa and intestinal fistula, the kidneys excrete chloride in excess of sodium. This selective capacity of the renal tubules is an important factor in the maintenance of the acid/base equilibrium of the body, for any significant change in the acid/base balance of the body fluids is prevented by renal excretion of a more than normally acid urine when there is an increase of acids in the blood, and of a neutral or alkaline urine when there is an increase in blood alkalinity. The normal condition of the blood and intracellular fluids is one of slight alkalinity and it is dependent mainly upon sodium and potassium, the former predominating in the plasma and the latter in the cell water.

From the foregoing it will be seen that varying the acid/base relations in diet is sometimes a valuable form of diet therapy. Diets in which base-forming foods predominate have been advised in the treatment of acidosis, in some forms of nephritis, and in conditions wherein it is desirable to render the urine alkaline. Acid-forming diets have been recommended for infections of the urinary tract, for increased excretion of urinary phosphates, and in some forms of œdema.

CHAPTER 4

THE NORMAL DIET (*continued*)

VITAMINS

When the human race lived upon a variety of naturally produced foods in their normal state the group of conditions that have been called 'deficiency diseases' was unknown. With the development of industries that necessitated the congregation of the greater proportion of the population into cities far removed from the source of food supplies, methods of food preservation were introduced that were later proved to result in the destruction of substances essential to the maintenance of health. Grains were 'refined' by the removal of their husks, together with the germs that lay immediately underneath, and, although the resultant products were then regarded as more appetizing than the grain in its natural state, the removal of the germ also removed factors that were necessary for correct metabolism, with the result that, when polished grain formed the main article of diet, hitherto unknown diseases developed, and in many cases proved fatal. Fresh fruits and vegetables were cooked or were preserved by heat or by drying, and these processes destroyed the food factor that is necessary to prevent scurvy. The habit among civilized peoples of covering the greater part of the skin, so that the ultra-violet rays of the sun reach little more than the face even when sunlight is not excluded by the pall of smoke that often hangs above cities, prevents the formation of a natural product that is necessary for the utilization of calcium, and thus results in defective mineralization of bones and teeth.

It was not until the beginning of this century, however, that it was realized that dietary defects were responsible for these various conditions; and it is probably true to say that the science of nutrition had its beginnings in the systematic research that led to the recognition of the organic chemical substances now known as vitamins, and the

realization of the fact that it is these substances that prevent the occurrence of specific deficiency diseases and of vague states of ill-health. Although the scientific knowledge of vitamins dates from this century only, their presence was suspected as long ago as 1753 when Sir James Lind wrote a 'Treatise on Scurvy', showing that this disease of seamen could be prevented by giving them sufficient fresh fruit and watercress. Captain Cook, during his Polar expedition, kept his crews free from scurvy by similar means. A century ago, Magendie, as a result of experimental dieting of animals, found that the exclusion of animal fats and fresh plant substances was followed by a disease of the eye that is now called xerophthalmia. Livingstone also described this condition as occurring among his native servants in Africa, stating that 'the eyes became affected as in the case of animals fed upon pure gluten, starch, and sugar'.

The earliest significant experiments in the search for vitamins were carried out in Switzerland, in 1888, by a chemist named Lunin. He fed mice upon a diet of synthetically prepared protein, carbohydrate, fat, and inorganic salts, and found that the animals did not survive; but that life could be maintained if milk was added to the dietary. His reports received little attention until 1905, when Pekelharing, in the Netherlands, repeated them and confirmed Lunin's findings. Professor F. G. Hopkins, of Cambridge, carried out a long series of experiments from 1906 onwards. His discoveries constitute our first real knowledge of these important substances, and he called them 'accessory food factors'. In 1912 a Polish biologist named Casimir Funk, who was working at the Lister Institute in London, published his 'vitamine theory', introducing a new word into the English language. The chemical composition of the substances was not known at that time. Funk and other investigators thought that they belonged to a class of organic derivatives of ammonia that are known as *amines* and that they were vital to the maintenance of health—hence the name by which he called them. By the year 1920 it had been found that none of the vitamins then known really belonged to the amine group of chemical substances, and Professor Drummond proposed that the terminal 'e' should be omitted. His proposal was adopted and the word passed into current speech and literature in its present form.

At first, the vitamins were named by the letters of the alphabet in the order of their discovery. So little was known regarding them that

it was difficult to find suitable designations; but as their chemical composition became known and it was found that many of them could be produced synthetically, the tendency to call them by their chemical names gained ground, especially as these names are the official terms for those that are now included in the British Pharmacopœia. Some of the vitamins originally described under an alphabetical name have now been found to contain many different factors and this has added to the confusion in terminology; for investigators in different laboratories and different countries used different names to designate the newly discovered substances. For example, when vitamin B was found to contain an anti-neuritic and an anti-pellagra factor the former was called vitamin F, after its discoverer, Funk; and the latter vitamin G, after Goldberger, who did much of the original work that related to its connection with pellagra; and it has also been called the p.p. vitamin (pellagra preventive). These terms were especially popular in America; but in this country the two factors were called vitamin B_1 and vitamin B_2 respectively. Later it was found that the substance hitherto known as vitamin B_2 was not the anti-pellagra factor but was a yellow, fluorescent pigment that was first named *lactoflavine* and later *riboflavin*, by which name it has continued to be known. Eventually the anti-pellagra factor was isolated from the vitamin B complex and was named *nicotinic acid*. The anti-neuritic factor is now called *aneurin* or *thiamin*, the former term being used chiefly in this country and the latter in America. In the following descriptions of vitamins and their uses the alphabetical designations will be employed because they are not yet obsolete, but the chemical names of the substances will also be given where they are generally recognized.

Practically all the experimental work in connection with vitamins has been carried out on small animals, such as mice, rats, guinea pigs, and pigeons. These animals have a rapid span of life and several generations can be studied in a small space of time; and they consume relatively small amounts of food. The results obtained with these animals may usually be interpreted as being similar to those that would occur in human beings on a diet with similar deficiencies. This is not always so, however, for a number of vitamins have been found to be essential for certain processes in animals whilst their exclusion from the diet of a human being is not followed by any impairment of health or function.

Fundamentally, vitamins are organic chemical substances that develop in plants that have grown in sunlight, in the flesh of animals that have grazed upon sunlit pastures, in small fish that live upon the green algæ of the sea, and in larger fish that subsist upon the algæ-eating species. Although they are essential to life and to health, they neither build tissues nor supply the food that is required for the generation of heat and muscular energy. The known vitamins are classified into two groups, according to whether they are soluble in fats or in water.

FAT-SOLUBLE VITAMINS

VITAMIN A

This substance was discovered in 1913, almost simultaneously by workers in America and Britain. As far as is known, it occurs in nature exclusively in animal tissues and chiefly in the form of fatty esters; but the primary sources of vitamin A are the carotenoid pigments synthesized by plants, these pigments containing beta-carotene. When taken into the body, each molecule of beta-carotene is split and, by combining with water, forms two molecules of vitamin A. This process is thought to take place in the liver, where the vitamin is then stored. Commercial vitamin A concentrates are obtained by distillation of cod, dog-fish, and shark liver oils.

Dietary sources. The chief dietary sources of vitamin A are animal liver and kidneys, the fat of meat and of fat fish such as herrings, mackerel, salmon, sprats, and sardines. Milk, cheese, butter, and egg-yolk contain both vitamin A and carotenoid pigments. Summer milk and milk products have a higher content than winter milk because the cows are out at pasture during the summer months, whereas they are stall-fed during the winter. Carotene was first discovered in carrots, hence its name. The vitamin A-active constituent is beta-carotene, and this is present in the carotenoid pigments of tomatoes and all leafy green and yellow vegetables and yellow fruits, good sources being swede turnips, peaches, apricots, bananas, dates, and prunes. The outer green leaves of cabbage and lettuce contain beta-carotene, the amount depending upon the degree of sunlight they have received during their growth; but the inner white leaves of the heart contain none. In tomatoes the yellow colour of the pigment is masked by a red pigment and in green leaves by chlorophyll. There are thus two sources of vitamin A available to man—the already

developed product in animal foods and its precursor, beta-carotene, from which the body can synthesize its own vitamin A.

The cod and the halibut, both of which are deep-sea fish, obtain their vitamins by a very interesting cycle. Microscopic marine plants, known as green algæ, develop carotene and are devoured by minute shellfish that float upon the surface of the water. These in turn are ingested by small fish that form the food of larger fish which are then devoured by the cod and the halibut. These two fish store quantities of both vitamins A and D in their liver and roe, and these factors are contained in the oil expressed from the fish livers; halibut liver oil being nearly fifty times richer in vitamin A than cod liver oil, which it has largely replaced in medical practice. It is less unpalatable and much smaller doses are needed in order to obtain the required amount of the vitamin.

Vitamin A is absent from lard, bacon, and pig fat, for pigs are not, as a rule, given greenstuffs in their dietary. Lard is in contact with air during its purification; and, although stable to heat, vitamin A is impaired by oxygen. It is deficient in dripping and also in vegetable fats, from which most margarine is made, but, in accordance with a Government order, vitamins A and D are added to all margarine sold in this country, the amount of the former being 550 International Units per ounce. The normal daily requirements for health have not been exactly determined. For adults they have been estimated at between 2,400 and 4,600 I.U., but growing children should have double this amount, and so also should pregnant women and nursing mothers.

Absorption and storage. The absorption of both vitamin A and carotene from the intestine requires the presence of fat, and for the absorption of carotene bile salts are also required. Therefore, in cœliac disease, cystic fibrosis of the pancreas, biliary and intestinal obstruction, enteritis, ulcerative colitis, and dysentery there is poor absorption of these important food factors. This has been noticed particularly in tuberculous enteritis and it is significant that there is reputed to be a high incidence of impairment of 'dark adaptation' in the tuberculous, and also in chronic liver or biliary disease and in practically all disorders of digestion and absorption. The taking of liquid paraffin or preparations of agar before meals reduces absorption of carotene by carrying away considerable amounts in the fæces, as happens also in inflammatory conditions of the large bowel.

Uses of vitamin A. The most important functions of vitamin A are to promote the nutrition of epithelial tissues and to regenerate the visual purple in the retina. It is thought to be necessary also for correct skeletal growth and for the growth and function of the tissues of the central nervous system.

When the vitamin is deficient or absent, epithelial cells tend to atrophy; they then become hardened, or keratinized, and desquamate. Secretory ducts become choked with debris which forms a breeding ground for bacteria. The chief tissues to be thus affected are the conjunctiva, the cornea, the mucous membranes lining the respiratory, the gastro-intestinal, and the genito-urinary tracts, and, to a lesser extent, the skin. The keratinized condition of the cornea is called *xerophthalmia* and, if unchecked, it leads to the formation of corneal ulcers and to subsequent blindness. Children living on diets that are poor in vitamin A are particularly liable to this disease. Local treatment of the eyes has no effect, but the condition is relieved and arrested if cod or halibut liver oil is given. During the war of 1914–18 there were many epidemics of xerophthalmia, especially in Denmark, from which country nearly all the butter and other dairy produce was exported and children of the poorer classes were fed mainly upon skimmed milk and cereals. It has been very prevalent in Greece during the recent European war, where large numbers of children have become permanently blind.

Some years ago vitamin A was popularly called the 'anti-infective vitamin', and it was suggested that an excess of it would help to prevent the common cold, broncho-pneumonia, and gastro-enteritis. The present view is that, although keratinization of mucous membranes renders them more prone to infections, the taking of amounts larger than are necessary to keep these tissues healthy has no protective value.

Retinal changes resulting from deficiency of vitamin A lead to an impaired adaptation to dim light—the so-called 'night blindness', the technical terms for which are *nyctalopia* and *hemeralopia*. This has been found to be due to exhaustion of a colouring substance, called visual purple, in the retina. This substance is normally bleached to a yellow colour by light, but it is quickly regenerated as vitamin A passes from the blood through the choroid and pigment layers into the retina, where it combines with a protein substance, and a thermal reaction converts the resulting compound into visual purple. This

process occurs continually; but in a person in whom vitamin A is deficient the ability to reconstruct visual purple is impaired, especially after it has been completely exhausted by strong daylight. The condition, though not the cause, has been known since antiquity. Hippocrates mentions it in the fifth century B.C., and he prescribes raw liver for its cure. In Newfoundland, where fishermen are particularly affected as a result of the glare of sunlight on their eyes, the people have long believed that eating the liver of the cod-fish or the seagull is a prompt cure. It is now possible to measure the degree of impairment of vision in dim light by the 'dark-adaptation test'. The maintenance of normal dark-adaptation is considered to be the best criterion of adequate intake and absorption of vitamin A.

With regard to the part played by vitamin A in promoting normal growth it must be remembered that when there is a shortage of any vitamin it is probable that the diet is inadequate in other constituents also; but it is claimed that deficiency of vitamin A leads to a greater retardation of skeletal growth than of the tissues of the central nervous sytem, the result of this being an overcrowding of the cranial and spinal cavities, with herniæ of nerve roots through the intervertebral foramina.

VITAMIN D

This is the anti-rachitic vitamin, its essential function being to control the calcification of the skeleton—for the metabolism of calcium and phosphorus cannot proceed without it. It will not, however, compensate for lack of these two minerals. It is a fat-soluble substance, but very few natural foods contain more than a trace of it. The only rich food sources are cod and halibut liver oils, but it is present in variable quantities in oily fish, such as herrings, sardines, sprats, and salmon. Summer milk, cream and butter, and the egg-yolk of birds exposed to sunlight are fairly good sources. Winter farm produce contains but little. So that even a well-balanced diet that supplies all other food substances in adequate amounts will probably provide less vitamin D than the body requires. This is particularly true in childhood and in pregnant and lactating women.

Fortunately, considering the few dietary sources of this vitamin, man is able to synthesize it for himself by the action of the ultra-violet rays of sunlight upon ergosterol—which is present as a waste

product in the fatty matter of the skin. Similar processes occur in certain plants, such as ergot and yeast, giving rise to irradiated ergosterol. Ergosterol was first described many years ago by a French chemist named Tancret. He isolated it from ergot, a fungus that grows on rye. In 1927 it was found, almost simultaneously by investigators in London and in Germany, that ergosterol was the parent substance, or precursor, of vitamin D_1 and in the same year the chemical composition of the vitamin was ascertained. Later, in 1932, it was found that a substance having much the same characteristics could be synthetically produced and could be developed in foods by a process of controlled irradiation by ultra-violet light or by electrons emanating from the cathode of an X-ray tube.

Ten forms of vitamin D have been identified, but only three of these are of clinical importance. These are the natural product which is known as vitamin D; the product which is formed by the irradiation of ergosterol in the laboratory and which is known as vitamin D_2, or calciferol; and a substance formed by the irradiation of a 7-dehydrocholesterol found in animal foods, the product being designated vitamin D_3. Some authorities mention a substance called vitamin D_4 developed by irradiation of vegetable foods, but its anti-rachitic value is low. The substance once known as vitamin D_1 has been found to have no anti-rachitic power at all, and the term is now obsolete. Vitamin D is included in the Addendum of the British Pharmacopœia under the name of calciferol. It is also called radiosterol and viosterol.

Stability of vitamin D. In sealed ampoules that are kept in the dark it retains its potency almost indefinitely, and in ordinary dark glass bottles it remains stable for many months; but if it is kept in containers exposed to light, or opened frequently, it deteriorates in a comparatively short time. The small amounts of naturally occurring vitamin D in foods and the larger amounts developed in them by irradiation are not adversely affected by cooking or by canning.

Results of vitamin D deficiency. Because the normal utilization of calcium and phosphorus cannot take place, a deficiency of vitamin D gives rise to rickets in children and osteomalacia in adults. In a baby with rickets the bones do not become sufficiently hardened during the first year of life to support his weight, so that as soon as he begins to walk the soft bones of the legs bend under him. His teeth are late in erupting and are prone to become carious. The anterior fontanelle, which should ossify by the end of the first year, is found to be still

membranous in the second year of life. Rachitic deformities of the skull, thorax, and pelvis may also develop. Many children admitted into hospitals show signs of a rachitic tendency, but improve with dietary adjustment and artificial sunlight treatment.

If the diet of an expectant mother is deficient in vitamin D, or in calcium and phosphorus, the child's bones will not ossify correctly and the teeth—which are developed in the jaws in pre-natal life—will not be well formed. The mother herself will suffer from dental caries and, in extreme cases, from osteomalacia or adult rickets. This disease was very prevalent in the zenanas of India when girl-mothers were kept in strict seclusion and lacked not only the foods containing vitamin D but also sufficient exposure to sunlight to produce the vitamin for themselves. As 'hunger osteomalacia' it ravaged the populations of the great European cities in the years immediately following the war of 1914–18; in fact, great advances in knowledge of the part that vitamin D plays in preventing and treating these diseases followed the work of Huldschinsky, the Jewish physician in Berlin, who first showed that infantile rickets could be cured by exposure of the rachitic child to the ultra-violet rays of a quartz-mercury vapour lamp. The subsequent work of Dr. Harriette Chick and her colleagues who were sent out from this country to study the problem of widespread hunger osteomalacia in Vienna added greatly to the realization of the importance of vitamin D in maintaining the correct calcification of bones and teeth. Both rickets and osteomalacia again became rampant during the German occupation of European cities during the war of 1939–45, especially in the Low Countries; but these diseases were practically non-existent in Japanese prisoner-of-war camps, in spite of the privations endured, for they seldom occur in countries where sunlight is adequate.

Available preparations of vitamin D: *Cod liver oil.* Because it is cheap and safe, cod liver oil is probably the most widely used medium for the administration of vitamin D. It has the additional advantage of containing vitamin A and of possessing a high Calorie value. It is included in the Addendum (1940) of the British Pharmacopœia as *Oleum vitaminatum*, standardized to have a minimum content of 85 I.U. of vitamin D per millilitre; but many good brands that are marketed contain 100 to 150 units per ml. Therefore, one teaspoonful will supply from 350 to 600 units, the vitamin D content usually being stated on the label. Most infants and young children quickly learn

to like the taste of cod liver oil, which is much better as an anti-rachitic in its natural state than when emulsified or made into an oil and malt mixture. Emulsified cod liver oil may contain only 25 per cent, and cod liver oil and malt only 10 per cent, of the vitamin D that is present in cod liver oil itself.

Halibut liver oil. This is available as *Oleum hippoglossi* (B.P.). Because its vitamin content is much higher than that of cod liver oil it is often diluted with some less potent oil in order to facilitate the measurement of appropriate doses. Even then the product as marketed may contain 1,000 units per millilitre, the amount being stated on the label.

Fish liver oil concentrates. The vitamin D of fish liver oils is present only in the saponifiable fraction, and as this fraction can be isolated by chemical means a concentrate can be obtained that has a much higher vitamin D content than the original oil. Such concentrates are used much more in America than in this country.

Artificially activated concentrates. These are prepared from calciferol, or crystalline vitamin D, which is made by the irradiation of ergosterol or of 7-dehydro-cholesterol. The crystalline substance is diluted with corn oil or some other organic solvent. Each minim of *Liquor vitamini D concentratus* (B.P. Addendum, 1940) contains 500 units of vitamin D. The great advantage of such a concentrate is that very small amounts are usually required and large doses can be given in small bulk, and they are most useful for children with fat dyspepsia or with an idiosyncrasy to fish liver oils. The anti-rachitic potency of calciferol and of vitamin D_3 is equal to that of the naturally occurring vitamin.

Irradiated foods. The anti-rachitic value of milk can be increased by feeding the cows on irradiated yeast, by irradiating the milk itself, or by adding a vitamin D concentrate to it. In some cities pasteurization and irradiation is combined. The vitamin D content of irradiated milk is difficult to estimate, and it varies between 135 and 200 units per quart. Most evaporated milk is enriched by irradiation. When vitamin D concentrates are added to milk it is usually standardized to contain 400 units per quart. Cereals and eggs can also be enriched in similar ways. The disadvantage of irradiated foods as a substitute for fish liver oils or vitamin D concentrates is that the anti-rachitic potency of the foods cannot be determined prior to their use, whereas fish liver oils and vitamin D concentrates can be and are, standardized.

Prophylaxis of rickets. Although rickets has a lesser incidence among breast-fed than bottle-fed babies, breast feeding is not a specifically protective factor; for much depends upon the mother receiving an adequate supply. Even irradiated cow's milk will probably not contain more than 70 I.U. per pint, so that it cannot be considered as an entirely satisfactory source of vitamin D for infants and young children. No definite estimate of requirements has as yet been worked out, but suggested supplementary amounts have been advised by authoritative workers on nutrition. In the prevention of rickets a good rule is to give vitamin D in quantities well above the minimum requirements for health, beginning in the third week of infancy by giving half a teaspoonful of cod liver oil, or one minim of halibut liver oil, daily. This provides about 200 I.U. The dose may be gradually increased to four times this amount by the end of the second month, and be continued until the child is at least two years old.

It is necessary, also, to encourage the formation of vitamin D by the child himself. To this end he should be taken into the open air, preferably in a garden, a field, or a park, for as long as possible each day, in all weathers except fog, gale, heavy rain, or snow. The presence of snow on the ground increases the intensity of ultra-violet light by reflection. Even when the sun is not actually shining, a clear sky will give a light in which the sun's radiations are reflected and scattered. Such light has considerable anti-rachitic power; but whether sunlight or 'skyshine' is the available medium of ultra-violet light it is necessary that the rays shall fall upon the skin, so that at least the child's face, arms, and legs should be uncovered, except in very cold weather.

Use of vitamin D in other conditions. An increased intake of vitamin D has resulted in an improvement in some cases of tetany, arthritis, hay fever, and psoriasis, and it has been observed to promote union of fractures in old people and in others in whom union was delayed; supplementary amounts of 400 to 500 units being given daily, together with calcium gluconate or lactate. In senile osteoporosis, which may be associated with fractures and deformities, the giving of calcium and phosphorus and comparatively large doses of vitamin D has been followed by some degree of improvement; but since kidney function is often impaired in old age the danger of overdosage with vitamin D must be remembered, and care must be taken that the diet is adequate in all other respects. Calcium and vitamin D therapy will sometimes overcome a tendency to chilblains.

Toxicity of vitamin D. The margin of tolerance for vitamin D is not definitely known, but adverse symptoms seldom appear until many times the therapeutic dose has been taken, probably as much as 500,000 units a day. A condition known as *hypervitaminosis D* may then develop in which there is a marked rise in blood-plasma calcium. This apparently promotes the absorption of so much lime that excess deposits lead to calcification of blood-vessels and lime deposits in the kidneys, the liver, and the heart. The early symptoms of vitamin D toxicity are headache, nausea, diarrhœa, and loss of weight; but many of the symptoms that follow massive overdosage with vitamin D occur also in hyperparathyroidism.

VITAMIN E, OR TOCOPHEROL

This is found in animal fats in association with vitamins A and D; but its richest source is the oil extracted from wheat germ. It is stable to high temperatures but it is rapidly destroyed by rancidity, even at ordinary room temperatures. It can be produced synthetically, the synthetic compound being much more easily obtained than the natural vitamin and having an equal potency. The name 'tocopherol' was taken from 'tokos'—childbirth, 'phero'—to bear, and 'ol' indicating an alcohol. It is regarded as an anti-abortive vitamin. Most of the information concerning the effect of tocopherol upon reproduction was obtained from studies on the rat. It had been recognized that deficiency of this vitamin caused the fœtuses of female rats to be absorbed, whilst male rats developed testicular atrophy. It has not been conclusively proved that tocopherol is necessary for human reproduction, but it is claimed that it has been used with success in the prevention of abortion in young women who had previously had several miscarriages. These women were, however, under medical supervision throughout their pregnancies, so that their general health was maintained and they were relieved of anxiety with regard to their capacity to carry their babies to full term. It is, therefore, rather difficult to evaluate the effect of the administration of the vitamin.

Some years ago interest was aroused with regard to the influence of tocopherol on the normal development and maintenance of the muscular and nervous systems, for it had been shown that young rats and guinea pigs born of mothers partially deficient in vitamin E

developed an incurable paralysis when about three weeks old, the paralysis being due to degeneration of the fibres of voluntary muscle; but the condition could be prevented by adding vitamin E to the diet of the mother animals. It was thus established that, at least in rats and guinea pigs, vitamin E plays an important part in maintaining the integrity of voluntary muscular tissue. Further studies on chickens indicated that vitamin E was essential for the integrity of the tissues of the nervous system, for a deficiency was followed by lesions in this system. Recent research suggests that in the absence of vitamin E a large part of the carotene taken in food is destroyed in the gastro-intestinal tract and, seeing that animals are entirely dependent upon carotene for their supplies of vitamin A, symptoms indicative of vitamin A deficiency developed.

Human requirements and clinical uses. Although it is now generally recognized that most small animals and birds require vitamin E there is less agreement with regard to the needs of larger animals, and it has never been definitely proved that human beings need it at all—but neither has it been proved to have no effect upon human health. There have been numerous reports of its use in the treatment of muscular dystrophy in children, and of progressive muscular atrophy and other diseases associated with degenerative changes in muscular and nervous tissues in later life. It has been claimed that improvements have followed in many of these cases, but other authorities regard these results as being open to the same criticisms as have been mentioned in connection with the administration of vitamin E in the prevention of abortion. In 1941, C. L. Steinberg of America reported upon a series of cases of primary fibrositis treated by the administration of 2 to 8 cubic centimetres of wheat germ oil daily with a cure in all but two patients, these two showing some improvement. No improvement followed upon similar treatment in cases of secondary fibrositis.

VITAMIN K, OR MENAPHTHONE

This is an anti-hæmorrhagic factor discovered by Professor Dam, of the University of Copenhagen, in 1929. Its effect is to stimulate the production by the liver of the prothrombin of the blood. When vitamin K is deficient the clotting time of the blood is unduly protracted and there may be subcutaneous, intramuscular, or abdominal hæmorrhages.

Vitamin K has a wide distribution in nature. Spinach, cauliflower, cabbage, and alfalfa are its richest sources, other good sources being carrot tops, kale, young cereal plants such as wheat and oats, chestnut leaves, soya bean oil, and pig's liver. It can be synthesized in the intestines as a result of bacterial growth. Dietary deficiencies are rare, for an adequate amount of vitamin K is supplied by any normal diet, but it cannot be absorbed from the intestine in the absence of bile salts; so that in persons suffering from impaired liver function, obstructive jaundice, or external biliary fistula—when no bile reaches the intestine—no absorption of vitamin K takes place and, therefore, the liver is unable to produce prothrombin.

In 1939, the pure vitamin K was isolated from a fodder lucerne known as alfalfa. A few months later, three synthetic compounds of vitamin K were produced. One of these—2-methyl-1 : 4-naphthaquinone—is now included in the British Pharmaceutical Codex under the name of menaphthone. It is inexpensive to synthesize, easy to administer and it gives satisfactory results, so that the synthetic product has largely replaced the natural vitamin in medical practice.

Synthetic vitamin K is issued in ampoules containing 5 milligrammes in 1 cubic centimetre of an oily solution for intramuscular injection, and its sodium salt is available in an aqueous solution for intravenous use. It can also be given orally, with the addition of bile salts when these are not present in the intestine. Its administration has been found to prevent the troublesome oozing of blood that so often follows operations on the bile ducts and gall bladder. It has also been used in the prevention and treatment of pre- and post-partum hæmorrhage and in hæmorrhage of the new-born. In obstetric practice it is rapidly becoming a routine procedure to give vitamin K orally during the last few days of pregnancy, for its effect upon both the mother and the infant. Its administration is followed by no toxic results even when oral doses of 25 to 50 milligrammes or intravenous doses of 5 to 10 milligrammes have been given. This vitamin has no beneficial effect in hæmophilia.

THE WATER-SOLUBLE VITAMINS

THE VITAMIN B COMPLEX

The substance originally called water-soluble vitamin B was soon found to be composed of at least two substances, the absence of one

resulting in a disease of the nervous system known as polyneuritis or beri-beri, and the absence of the other causing a condition characterized by diarrhœa, dermatitis, and dementia, that was called pellagra. On the recommendation of an Accessory Food Factors Committee, appointed in London in 1927, the symbol B_1 was used in all British literature for the anti-beri-beri factor and the symbol B_2 for the anti-pellagra factor. Meanwhile, American writers continued to call the former vitamin F, and the latter vitamin G or the p.p. vitamin. We now know that vitamin B_2 contains at least nine factors, each of which appears to play a part in animal or human metabolism; but only in regard to three of these factors is there conclusive evidence that they are essential to the well-being of man. These are aneurin or thiamin, which is the original vitamin B_1, and riboflavin and nicotinic acid which are contained in the vitamin B_2 complex. Others, such as pantothenic acid, pyridoxine, biotin, inositol, para-aminobenzoic acid, and folic acid, that have hitherto been regarded as essential to the health of rats, pigeons, chickens, pigs, and dogs, are forming the subjects of widespread investigation in connection with their possible clinical uses. Choline is also receiving a good deal of attention in this respect although its claim to be a member of the B group of vitamins is questioned.

ANEURIN, OR THIAMIN

Vitamin B_1 was first isolated in 1926, from rice polishings by Jansen and Donath in the Dutch East Indies, and they called it *aneurin*. When it was found to contain sulphur the name *thiamin* was suggested as a better designation, especially as it is the only sulphur-containing vitamin as yet known. It can be prepared in pure crystalline form from yeast and from the polishings of rice. It was first synthesized in 1937, the synthetic product being included in the Addendum, 1940, of the British Pharmacopœia as *Aneurin hydrochloride*, the term *thiamin* being given as its synonym. One milligramme of pure aneurin contains 333 I.U.

Food sources. The germs of cereals rank highest as sources of vitamin B_1 in human foods. Unfortunately, so many cereals are refined by processes which remove the germ with the husk and leave the grain quite devoid of aneurin; but since January 1941, all flour sold in this country has had aneurin added to it. Legumes are impor-

tant sources, although much of the vitamin is lost during the process of cooking, especially in the presence of alkalis and when temperatures above 110° C. are employed. A certain amount passes into the cooking water and this should, therefore, not be thrown away but be utilized in the making of soups. Yeast has a high aneurin content, and nuts, egg-yolk, liver, and pork are good sources; the amount present in animal foods depending upon the dietary intake. Bemax and Marmite are rich sources of this vitamin and of the other factors in the vitamin B complex. Some of the poorest food sources of aneurin are milled cereals, white flour, beef muscle, milk, and fresh peaches.

Uses and results of aneurin deficiency. The function of aneurin in human beings has been shown to be the prevention, by oxidation, of the accumulation of pyruvic acid as an intermediate product of carbohydrate metabolism. Pyruvic acid has been found in the brains of pigeons suffering from polyneuritis. The clinical test, in human beings, for aneurin deficiency is the presence of excess pyruvic acid in the blood.

With slight deficiency of aneurin the onset of symptoms is insidious. The manifestations are varied and include muscular weakness, loss of appetite, vague abdominal discomfort with constipation, neuralgic pains, and odd sensations of tingling in the limbs. The person becomes irritable, depressed, and quarrelsome. Later, there may be progressive anæmia, dyspnœa, tachycardia, low blood-pressure, and œdema. It is thought that vitamin B_1 deficiency may be an important factor in the causation of marasmus in babies. Its absence from a diet causes polyneuritis, or beri-beri, which is characterized by paralysis, muscle wasting, abdominal distension due to defective peristalsis, œdema, and heart failure. The disease is prevalent among races that subsist largely upon a diet of polished rice or maize. Its incidence was high in the prisoner-of-war camps under the Japanese during the recent World War, and also among the Japanese armies, particularly in Burma.

Human requirements. The precise human requirements of aneurin are not known. It is so widely distributed in foods that the amounts contained in an ordinary mixed diet are difficult to estimate. Under normal conditions the amounts required vary according to whether a person is engaged in sedentary, moderately active, or very active occupations; for any increase in carbohydrate metabolism demands an increase in aneurin in order to oxidize the intermediate products

completely and so to prevent the accumulation of pyruvic acid, the toxic effects of which are thought to account for all the symptoms of aneurin deficiency. Persons living on a diet containing a high proportion of refined carbohydrates may show symptoms of aneurin deficiency and, as this vitamin is rapidly destroyed in an alkaline medium, such symptoms are prone to develop in conditions associated with hypochlorhydria and achlorhydria unless the vitamin is given parenterally. Pregnancy, lactation, and pathological conditions such as fevers and hyperthyroidism, wherein metabolism of carbohydrates is generally increased, raise the aneurin requirements of the body. The post-operative anorexia, nausea, vomiting, intestinal distension, and paralytic ileus that often develop when patients are fed only on glucose drinks or by intravenous injections of glucose solutions are now thought to be due, at least in part, to the absence of aneurin and the consequent accumulation of pyruvic acid in the body; and it has become a common practice to add aneurin to the glucose solution. Often, ascorbic acid and riboflavin are also added, as the need for these two vitamins is thought to be increased under such conditions.

RIBOFLAVIN

Before its chemical nature was known, riboflavin was called vitamin B_2 or vitamin G, and it was thought to be the substance necessary for the prevention of pellagra. It is now known that it has no influence upon pellagra, but that it is necessary to prevent cheilosis, glossitis, seborrhœic skin changes, and capillary injection of the conjunctiva and other ocular changes.

It was first isolated, in 1933, from yeast, milk, egg-white, liver, heart, brain, pancreas, and kidney; but it is also present in beet greens, spinach, green peas, cauliflower, and mushrooms. In its pure state it is an orange-yellow, crystalline powder, but it forms a pale greenish-yellow solution with green fluorescence in water. It is stable to heat but not to alkaline solutions at high temperatures.

As with other deficiency diseases, symptoms of ariboflavinosis may develop even when a diet is adequate if there is interference with absorption or there is an unusually high demand for the vitamin in question. Fully developed cheilosis usually appears as a transverse fissure at each angle of the mouth with varying degrees of reddening,

and scaliness of the lips. The fissures may be covered with yellowish, dried exudate. The tongue tends to be smooth, due to changes in the papillæ, and to have a magenta tinge. The skin changes involve seborrhœic accumulations of small, greasy, scaly masses in some of the folds of the body, such as at the alæ nasi, the outer canthus of the eye, behind the ears and in the axillæ and groins. If these accumulations are removed the skin under them is found to be reddened. The ocular changes may be mild or quite severe, with photophobia, excess lachrymation and engorgement of conjunctival vessels, and there may be corneal opacities.

Most of these symptoms can occur with other conditions, and a deficiency of riboflavin seldom occurs alone, for there is usually a deficiency of other vitamins in the B complex. Ariboflavinosis is treated by giving 1 ounce of dried yeast daily in divided doses or by giving the crystalline synthetic riboflavin in daily doses of 60 milligrammes by mouth or 20 milligrammes intravenously.

NICOTINIC ACID, OR NIACIN

In 1911, Casimir Funk isolated nicotinic acid from rice polishings while he was searching for the anti-beri-beri factor, and finding it ineffective in the cure of experimental polyneuritis he neglected it in his subsequent researches, as did all other nutritional investigators until 1937 when it was found to cure pellagra. Extensive clinical studies have been made during the past ten years and nicotinic acid is now recognized as the specific substance for the cure of pellagra.

The disease has been known in northern Italy since 1700. Indeed, the word pellagra comes from the Italian *pelle agra*, meaning 'skin seizures'. Although its incidence in Europe was decreasing before the Second World War, it was very prevalent in Spain, Roumania, the Balkans, and both North and South America. It was widespread among the native populations in parts of sub-tropical Africa, for example, Nyasaland and Rhodesia, where the main article of diet was maize meal. It is thought, however, that the amino-acid deficiency in the protein of maize may be a contributory factor, although it is significant that animal proteins are good sources of nicotinic acid. An outbreak of pellagra that occurred among natives in a prison in Rhodesia in 1932 was completely cured by considerably increasing the meat ration.

Food sources and uses. The most abundant food sources of nicotinic acid are dry yeasts and protein foods such as liver, pork, beef, lamb, and kidney. Other good sources are fish, egg-yolk, seakale, peas, and turnips. It is quite stable chemically and it is not destroyed by cooking. It is essential for the health of all ectodermal structures and it is notable that it is only these structures—the epidermis and its appendages, the lining of the respiratory and gastro-intestinal tracts and the tissues of the nervous system—that are affected in pellagra.

Results of deficiency. Early symptoms of pellagra are weakness, lassitude, anorexia, and indigestion, followed by sore and ulcerated mouth and by diarrhœa. As a result of the digestive disturbances the patient tends to live exclusively upon liquid foods and thus misses the small amounts of nicotinic acid that he may have been taking previously. A typical dermatitis occurs which tends to develop upon the parts of the body exposed to light, such as the face and hands. Later symptoms are pain in the back, tremor, especially of the hands, lips, and tongue, and involvement of the central nervous system that eventually leads to insanity with marked suicidal tendencies.

It is thought that nicotinic acid plays some part in the metabolism of sulphur, and it may be significant that there is some resemblance between the toxic symptoms produced by the sulphonamides and minor degrees of pellagra, for among the former are included skin rashes, nausea, vomiting, headache, and mental confusion; as well as sulphæmoglobinæmia. Nicotinic acid is often ordered for the relief of these symptoms, with good effect.

Treatment of pellagra. Synthetic nicotinic acid can be obtained in tablets each containing 50 milligrammes of the vitamin, for oral administration, or it can be given in the form of yeast or liver extracts. In extreme cases it can be given in doses of 50 milligrammes in normal saline by the intravenous or the intramuscular route, but it is seldom necessary to give it parenterally. Within twenty-four hours of commencing treatment an improvement is noticed. The glossitis and the soreness of the mouth are usually the first symptoms to be relieved and the patient expresses a desire for food. The ulcers beneath the tongue and on the lips usually heal within five days, and the skin lesions commence to disappear. The improvement in the mental condition is the most dramatic result of nicotinic acid therapy, the patient who had been completely disorientated often becoming entirely rational within a week of commencing treatment. But when the

psychoses have persisted over a period of months there may be irreparable damage to cortical cells and in these cases there can be no cure.

In addition to nicotinic acid therapy, the patient must be given a well-balanced diet rich in protein, but restricted in carbohydrate and fat on account of the digestive disorder that is present. Broths made from liver, lean meat, beef juice, and fresh vegetables are well tolerated and milk can be used in their preparation. Dried brewer's yeast is particularly valuable seeing that it contains not only nicotinic acid but all the other factors of the vitamin B complex. Until the dermatitis yields to treatment the patient should be protected from direct sunlight and the discomfort can be relieved by applying zinc oxide ointment to the lesions, Boroglycerine is found to be soothing for the stomatitis.

OTHER VITAMINS IN THE B COMPLEX

All other factors in the vitamin B complex that have been isolated are found in the same foods as the three that are known to be essential to man. Recent investigations have suggested that they may be of clinical use even if their absence from human dietaries results in no specific disease; and researches with regard to them are proceeding in many laboratories in different parts of the world. Claims of therapeutic usefulness have been made regarding the following but they have not yet been fully substantiated.

Pantothenic acid. The complete synthesis of this substance was achieved in 1940. Young pigs fed on a diet deficient in pantothenic acid do not take their food readily, they grow slowly, become thin and emaciated, lose their muscular co-ordination so that they 'goose-step', and may lose their hair. Post-mortem examination reveals gastritis and inflammation of the large intestine. In rats, a deficiency produces greying of the hair, nasal discharge, kidney and cardiac damage, and suprarenal necrosis; whilst in dogs there is a disturbance of lipoid metabolism.

Pantothenic acid has not yet been used clinically for human beings and no distinct relationship to human nutrition has been found; but many authorities suggest that in view of its importance to animals it would seem probable that it has some value to human beings.

Pyridoxine. This is a pyridine derivative the chemical composition

of which was discovered in 1939. It has been shown to be essential for the prevention of dermatitis and convulsions in rats, chickens, dogs, and pigs, but it has not been proved to have any function in human beings in health. Its clinical uses have formed the subject of conflicting reports; but it is claimed that its administration has been followed by improvement in some cases of persistent post-adolescent acne vulgaris, reducing the oiliness of the skin even to actual dryness in addition to its effect upon the lesions themselves. It has been used in the treatment of early cases of paralysis agitans and in pseudo-hypertrophic muscular dystrophy; but no definite claims as to its therapeutic value have yet been made.

Biotin. This is one of the more recently discovered vitamins in the B complex and it is believed to be necessary to human beings. In rats, whose only source of protein food was dried egg-white, a condition developed in which the chief symptoms were a characteristic eczematous dermatitis, with alopecia, spasticity and œdema of the feet. The typical dermatitis has also been found in chickens and turkeys. A substance was found in the vitamin B complex that protected against this egg-white injury and it was called *biotin.* Its chemical structure was ascertained in 1942 and the fact is established that it is inactivated by a substance in egg-white. In 1940 it had been shown that biotin was identical with the factor previously known as vitamin H. It has been suggested that the biotin deficiency in animals and the dermatitis of children known as Swift's disease are analogous.

Para-aminobenzoic acid. This was isolated from yeast in 1941 and in the following year its chemical structure was ascertained. It has been found that this substance 'blocks' the bacteriostatic effect of sulphanilamide *in vitro*. The symptoms that follow its absence or deficiency from the diet of rats and chickens are similar to those of a pantothenic acid deficiency, but there were extraordinary differences in pigmentation of both the skin and the hair.

Among its suggested uses in the human being is the possibility of its value in the treatment of alopecia areata and premature whiteness of the hair, and that further investigation of its interaction with the sulphonamides may enable the uses of bacteriostatic substances to be extended.

Folic acid. The biological importance of this factor was first suggested in 1941. Apart from its presence in foods such as green leaves, yeast, liver, kidney, and mushrooms, it is believed that it can be

synthesized in the body by the coliform bacteria in the large intestine. It has been found that it is essential for the formation of both the white and the red blood-cells. Research work is now going on with regard to its possible clinical uses in the treatment of blood diseases that have hitherto proved intractable.

In October 1943, W. H. Sebrell and H. S. Daft reported from Washington that when rats were fed on a diet containing sulphaguanidine or sulphasuxidine, which reduced bacterial activity in the intestine, they developed agranulocytosis, although the diet contained aneurin or thiamin, riboflavin, nicotinic acid, pantothenic acid, pyridoxine, choline, biotin, and calcium. But after four days' administration of folic acid the white cell count rose from 2,700 to 14,4000 per cubic millimetre, the percentage of granulocytes rising from 1 to 39.

T. D. Spies, working at a centre in Alabama where severe malnutrition is relatively common, has recently described the successful treatment of macrocytic anæmia with folic acid. Out of 42 patients so treated 26 responded well, and 5 of these had Addisonian, or pernicious, anæmia. Among others treated with folic acid were 8 patients with sprue, in all of whom the anæmia disappeared and the liquid, fatty stools became solid, brown fæces in a few days.

VITAMIN C

This is the anti-scorbutic vitamin. It was first isolated by the Hungarian biochemist Szent-Györgyi in 1927, from the adrenal cortex; but it was not until five years later that he or anyone else realized that it *was* vitamin C. He called it hexuronic acid. Later work showed that the same substance was present in fresh fruit juices and that it possessed anti-scorbutic activity. It is now synthesized as ascorbic acid, and the term hexuronic acid is no longer used.

Food sources. The amounts of vitamin C present in foods are variable, depending not only upon the kind of food, but upon the soil in which it has grown and the way in which it is handled, preserved, or cooked. The richest sources are oranges, lemons, grapefruit, strawberries, blackcurrants, gooseberries, and tomatoes, especially when these are eaten raw. Of recent years a syrup prepared from rose hips has been found to have a high vitamin C content. Broccoli, cabbage, potatoes, and turnips are equally as good sources as the

citrus fruits, but as they are practically always eaten after being cooked their vitamin C is then much less than in the uncooked fruits. Germinating pulses and sprouting vegetables are fairly good sources. Milk does not contain sufficient ascorbic acid to maintain perfect health, and patent foods contain practically none; so that orange juice, swede juice, or tomato juice must be given to babies who are artificially fed. When these juices cannot be obtained the synthetic ascorbic acid can be used.

Eggs, nuts, dried dates, figs and prunes, olives, mushrooms, and yeast contain no vitamin C at all.

Instability of vitamin C. Vitamin C is the most unstable of the vitamins. It is destroyed by slow cooking in the presence of oxygen and it is rapidly oxidized in an alkaline medium. It is, however, fairly stable in an acid medium, which may account for the fact that the acid fruits are such reliable sources of this vitamin. Copper acts upon it as a catalyst, so that milk, for example, should not be heated in a copper saucepan. It is not destroyed in cooking if enamelled or aluminium utensils are used and air is excluded, unless the cooking is prolonged or alkalis are added. Visible light is said to have a destructive effect upon it, even when passing through the glass of a milk bottle, but the slight amount of copper present in milk may be partly responsible for the oxidation of vitamin C. In the modern commercial processes of canning foods much of the air is removed before the food is sterilized by heat and therefore the majority of the vitamin is retained.

Human requirements. Man is entirely dependent upon dietary sources of vitamin C, for he is unable to synthesize any for himself. Neither are monkeys nor guinea pigs; but all other animals are believed to be able to do so. For adults, the dietary requirement of vitamin C is estimated at 75 milligrammes daily. A plentiful supply of fresh fruits and vegetables should supply all that is necessary, but when these are not obtainable ascorbic acid can be taken. This is available in small tablets, but in three sizes, containing 5, 25, and 50 milligrammes respectively. Infants require 30 milligrammes daily, which is the average content of half an orange. The minimal intake of orange juice should be one teaspoonful daily for the first month of life, increasing to four teaspoonfuls by the end of the third month; twice these quantities being given if tomato juice is used, or one tablet of ascorbic acid can be crushed for addition to the feeds each

day. For pregnant or lactating women 100 to 150 milligrammes should be taken daily. This may be more than the actual requirements, but the principle appears to be widely accepted that a high intake should be insisted upon; for any excess is readily excreted in the urine.

In certain pathological conditions the requirements for vitamin C are increased. During febrile states there appears to be either a greater utilization or a greater destruction of this vitamin. The common practice of giving large quantities of fresh fruit juice drinks meets the extra needs. All patients with chronic fevers require more vitamin C than healthy persons. Especially is this true of tuberculosis, and in these cases the diet may be supplemented by 150 milligrammes of ascorbic acid daily.

Vitamin C is recognized to be essential for the formation of red blood-cells. It is significant that the anæmia of scurvy responds to the administration of ascorbic acid but not to iron. When a patient is on a restricted diet, such as during treatment for gastric ulcer and some forms of dyspepsia, it is necessary to give either orange juice or ascorbic acid tablets.

Workers in lead industries are encouraged to take orange or other fresh fruit drinks daily, for vitamin C is believed to help in the prevention of lead poisoning. In the treatment of this condition 100 to 200 milligrammes. of ascorbic acid is often given daily for some weeks.

Results of vitamin C deficiency. A modern theory is that ascorbic acid is essential to the structure and function of fibroblasts and osteoblasts, that in its absence intercellular substances fail to form and the integrity of capillary walls is lowered so that these vessels become more permeable and fragile than is normal. The deterioration of existing intercellular tissues and their absorption are the chief characteristics of scurvy. The softening of bone callus, the occurrence of hæmorrhages and separation of epiphyses, the weakening of blood-vessels and the breaking down of old wounds can all be explained by this theory.

The chief symptoms of scurvy, or scorbutus, appear suddenly after a prolonged subsistence on a diet that is inadequate in vitamin C. They include loosened teeth and hæmorrhages into the gums, skin, muscles, and joints. Periosteal hæmorrhages occur and give rise to acute pain. In infants there is often swelling and tenderness of the thigh, with a disinclination to move; and the child cries when it is

handled. Petechiæ occur where clothing presses or rubs, particularly in the 'napkin area'. Adult patients complain of fatigue, breathlessness, palpitation, and rheumatic pains. They prefer to sit, but when standing they do not completely extend the lower extremities. In long-standing cases, both in infants and adults, larger subcutaneous hæmorrhages occur. In infants they are usually under the periosteum, around the epiphyseal cartilages, or near the eyes. In adults, hæmatoms may form in the muscles, and they have been found in the pericardium and other internal structures. There may be hæmaturia and bleeding from the bowel.

Scurvy is a comparatively rare disease in this country. It may occur in infants and young children fed on dried milk without the supplements of orange or other fruit juice or of ascorbic acid; and in old people living alone or in lodging-houses who have subsisted on a poor diet for a long time.

However severe the condition, the administration of vitamin C gives dramatic relief. Within twenty-four hours the pains diminish and movement becomes easier. Bleeding from the mouth and bowel stops and the hæmaturia ceases. Subperiosteal hæmorrhages are not so quickly controlled. Calcium is often deposited in the hæmatoms and it may take some months before the muscles and bones regain their normality. In some cases permanent arthritis may result.

In addition to the administration of vitamin C, careful nursing is necessary in the acute stage, the patient being handled as little as possible. Clothing should be so arranged that it can be changed easily, and if limbs are painful they should be lightly wrapped in cotton wool and the weight of the bedclothes relieved by a cradle. The arms may be lightly bandaged to the chest, or the lower limbs may be splinted. General hygiene must be improved, especially of the mouth, where the inflamed or ulcerated patches may be swabbed with hydrogen peroxide or be painted with 1 per cent gentian violet.

Pre-scorbutic conditions, or sub-scurvy, are still fairly common, for the vitamin C content of ordinary diets is often little above the level at which symptoms appear. In the past, epidemics of scurvy have raged amongst beleaguered armies and in besieged cities, and also in civilian populations during the occupation of countries by ruthless conquerors. Now, however, since the vitamin has been synthesized and the stable laboratory compound is available in unlimited quantities, armies and populations that had formerly to

rely upon concentrated and preserved fruit juice can be supplied with tablets of pure ascorbic acid; and these can be crushed for addition to infants', and invalids', feeds.

Vitamin P, citrin or hesperidin. This was first described by Szent-Györgyi and his co-workers in 1937. They isolated it from lemon juice and from Hungarian red peppers, and found it to be effective in the treatment of certain types of nutritional disorders characterized by increased capillary permeability. They called it citrin, and they claimed that it was responsible for preventing the leakage of blood from capillary walls such as occurs in purpura. It was because they considered it to be an anti-purpura factor that they designated it vitamin P. Further experiments showed that it consisted of hesperidin glucoside, so it was called hesperidin in this country. It has since been isolated from buchu leaves and from unripe oranges, and in lesser amounts from other fruits and vegetables.

Hesperidin has been used as a styptic in capillary hæmorrhage and it has been administered orally and intravenously in cases of allergic purpura and hæmorrhagic nephritis but without very encouraging results. Recently it has been used in the treatment of psoriasis. In a series of cases, about half improved when given hesperidin. In a second series treated by administration of hesperidin with ascorbic acid 19 out of 22 patients showed improvement; so that there appears to be a synergism between these two vitamins; but the value of hesperidin is still not conclusively assessed.

CHAPTER 5

THE NORMAL DIET (*continued*)

WATER AND OTHER BEVERAGES

Practically none of the functions of the body can be carried on without water. It is the principal solvent for all the substances that need to be transported in the blood and lymph streams and also for those waste products, other than fæces, that need to be eliminated. It diffuses through body membranes, giving volume and form to the soft tissues, and as a result of osmosis it regulates and maintains the correct specific gravity of intracellular and extracellular fluid and of the plasma.

It is estimated that 65 to 70 per cent of the weight of the body is due to its water content. Its distribution is controlled mainly by the various soluble salts, particularly the salts of sodium and potassium. Many functions of the body other than transport involve the utilization of water. For example, it is estimated that from 6 to 9 pints are poured out by the various glands associated with the alimentary tract each day, although a considerable amount of this is reabsorbed. Water is, however, constantly being lost from the body, the total loss during the 24 hours being about 4 pints; but this amount can be considerably increased under special conditions. The kidneys excrete 40 to 50 ounces in the urine, the fæces account for a loss of 5 ounces daily, 10 ounces are excreted as water vapour in expired air, and the loss by the skin is approximately 20 ounces daily as insensible perspiration, but several pints may be excreted by the skin when profuse sweating takes place; although in the latter case the loss is balanced by a diminution of kidney excretion. The 4 pints that are lost to the body under normal conditions must be replaced by fluid intake.

There are three sources of water supply to the body. Practically all solid foods contain 70 to 80 per cent of water and some as much as 90 per cent; so that an ordinary mixed diet may supply 35 ounces daily. The second source of supply is from the combustion of carbo-

hydrates and fats, and this will probably yield 15 ounces. There remains at least 30 ounces to be made up daily by the third source of supply, which is the ingestion of liquids. Thirty ounces is the very minimum amount of liquid that should be taken, and seeing that water assists in the dilution and removal of toxins and other waste substances, and in the regulation of body temperature, the optimum fluid intake for an adult is estimated to be from 3 to 4 pints daily.

Normal water balance. The 'water balance' in the healthy adult is the condition wherein the absorption of water from the alimentary tract together with the water produced by metabolic processes is equal to the loss of water from the body by respiration, perspiration, urination, and defæcation. If much more than the required amount is taken no disturbance of water balance will ensue if the kidneys are healthy and are functioning normally; for the ingestion of water is followed by diuresis in from 30 to 60 minutes and by the removal of all the excess water within four hours. The taking of salt by mouth may delay water diuresis by encouraging the retention of water in the tissues; which is the reason for the administration of saline solutions in conditions of dehydration. If the fluid intake is markedly less than the fluid loss a disturbance of water balance takes place. Charts that are often kept for patients who are liable to disturbances of water balance record the fluid ingested, or injected, as compared with urinary output; but they may be fallacious for they do not take into account the water content of solid and semi-solid foods nor the water produced by oxidation within the body; neither do they give any recording of the water loss by the lungs, skin, or bowels.

Dehydration. This condition occurs when the loss of fluid from the body is greatly in excess of the fluid intake. Vomiting, diarrhœa, and sweating are the usual channels of water loss and a corresponding loss of salts always accompanies the loss of water. If the water loss exceeds the proportionate loss of salts the patient experiences thirst; if the loss of water and of salts is in proportion a general and intense weakness occurs but thirst is not marked; and if the patient is given water alone muscle cramps are likely to result. The signs and symptoms of dehydration are loss of weight, dry, wrinkled skin, pinched facial expression with sunken eyes, impaired heat loss sometimes accompanied by rise of temperature, a rise in the non-protein nitrogen of the blood, and a disturbance of the acid/base equilibrium. A restric-

tion of fluid intake that is not sufficiently severe to cause definite symptoms of dehydration leads to scanty secretion of urine, hard, dry fæces, headache, nervousness, and a reduced secretion of digestive juices that may lead to vomiting or anorexia. Probably the inhibition of secretory function in the alimentary tract is a cause of the constipation. These symptoms rapidly disappear when the fluid intake is increased to make good the deficiency, provided that the salt intake is also adjusted.

BEVERAGES

Usually, only a small part of the fluid needed by the body is taken as plain water; by far the greater part of it being in the form of soups, milk, aerated mineral waters, tea, coffee, and other beverages. Milk contains 88 per cent water, there being not more than 12 per cent solids even in the richest milk.

Aerated mineral waters. These may be either naturally or artificially produced. The former are obtained from various mineral springs and they include *Apollinaris*, an alkaline aerated water containing sodium chloride, and carbonates of sodium, lime, and magnesium; *Perrier water*, containing sodium bicarbonate as its chief mineral; and *Johannis water*, which contains the same minerals as Apollinaris but is slightly more alkaline. These three aerated waters are suitable for ordinary table use, whilst *Vichy water*, which has a high acid-neutralizing power, is more suitable for medicinal use for people with hyperacidity and it is often preferable to an alkaline mixture.

Artificially aerated waters were first made by a chemist named Joseph Priestley about 1770. There are now many different forms on the market but they are all made by charging water with carbon dioxide at high pressure. Ordinary bottles of aerated water contain three to four volumes of carbon dioxide to one volume of water, whilst syphons contain more. The main advantage of aerated waters is that the giving off of the gas utilizes heat, and thus the water is much cooler to drink than ordinary water kept at the same temperature. Chemical salts are sometimes added to water before it is charged with carbon dioxide. *Soda water* contains 3 to 5 grains of sodium bicarbonate to the pint, whilst *medicinal soda water* contains 15 grains. *Potash water* contains bicarbonate of potash, *magnesia water* carbonate of magnesia, and *lithia water* carbonate of lithium.

The slight alkalinity of such waters renders them useful for diluting the more acid wines.

Seltzer water contains sodium chloride and bicarbonate, magnesium carbonate and hydrochloric acid. Some aerated waters are sweetened and are flavoured with citric or tartaric acid or with ginger. They may also contain acetic acid, but they do not contain fruit juices. Their refreshing effect when one is feeling rather exhausted is probably due to their sugar content.

Stone ginger is fermented ginger beer, and it usually contains at least 2 per cent of alcohol.

Cider. This is the juice expressed from mellowed apples. It has an alcoholic content of from 3 to 8 per cent—which is much the same as in beer. *Perry* is made in the same way as cider, using pears instead of apples.

Alcoholic drinks. Wines are made by the fermentation of grape juice. In natural wines, such as claret, sauterne, hock, and burgundy, the alcohol content varies between 7 and 16 per cent. Sherry, port, and champagne are fortified with additional alcohol, bringing their content up to between 18 and 20 per cent. Brown sherry often contains 23 per cent of alcohol.

Medicated wines usually consist of port or sherry with the addition of beef or malt extracts. Occasionally they also contain iron, quinine, pepsin, and other drug substances. Unless the amounts are definitely stated it is probably better to take the port or sherry by itself, and the extracts as required.

Apéritifs are wines containing some bitter ingredient that stimulates appetite.

Spirits are derived by distillation of fermented sugars. Almost any substance capable of yielding a fermentable sugar may be used. In this country malted and unmalted barley is used, particularly for whisky, but rye, maize, rice, and grape are suitable. Spirits contain from 20 to 70 per cent of alcohol—the poorer forms of whisky having only about 20 per cent, but the average quality has 30 per cent; gin has from 37 per cent upward, whilst Jamaica rum, which is made from fermented molasses, may have from 68 to 70 per cent of alcohol.

Beer, in its purest forms, is made from malted barley and hops. *Ale* is practically the same, but the darker malted liquors are known as *stout* and *porter*. Malt is obtained from germinating barley, the

process converting the starch into dextrose, which is then fermented with the addition of yeast. In making stout the malt is first roasted, which produces some caramel to which the darker colour is mainly due. Stout is about twice as acid as beer. Both beer and stout have a Calorie value of about 290 per pint, owing to their carbohydrate content, and they contain about 4 per cent alcohol.

Effects of alcohol. When taken in moderate amounts alcohol increases the secretion of gastric juice, but it does not increase the secretion of pepsin nor does it stimulate the muscular movements of the stomach. Excessive quantities give rise to profuse secretion of mucus in the stomach and to gastric catarrh. Because it is almost completely oxidized in the body it may be regarded as a food, for it yields about 7 to 14 Calories per ounce, varying with the type of beverage, but it cannot be stored in the body. Only limited amounts can be oxidized, the maximum being 10 cubic centimetres of pure alcohol per hour; which is about the amount present in half an ounce of good whisky, and no advantage is gained by giving larger doses than this. When taken with carbohydrate or fat it is preferentially utilized, the carbohydrates and fats being stored—which accounts for the fact that heavy drinkers are often overweight although their intake of food is not excessive. The most important action of alcohol is on the central nervous system. It often gives a feeling of well-being, good fellowship, and self-confidence, but it has been shown to depress the higher centres which normally exert a restraining influence on behaviour. Large doses lead to blunting of the finer senses, resulting in slower judgment and clumsy performance of movements demanding speed and skill. Its real value is as a narcotic and not as a stimulant.

TEA, COFFEE, COCOA, AND CHOCOLATE

Tea. In this country tea is probably the most popular beverage in all ranks of society. It is the dried leaves of the tea plant and it contains an alkaloid, caffeine, to which its stimulating property is due. It also contains tannic acid. Indian and Ceylon teas contain from 4 to 6 per cent of caffeine and 12 per cent of tannic acid; whilst China tea contains 2 per cent of caffeine and 6 per cent of tannic acid, but it has a more delicate flavour. The addition of milk to an infusion of tea precipitates some of its tannic acid. Tea also contains

a little protein, some mineral salts such as potassium, calcium, magnesium, and sodium; but no carbohydrate and no fat.

If tea is infused for three minutes in the usual way about 25 per cent of the weight of the leaf passes into solution. The caffeine is extracted much more readily than the tannin, so that the first cup is the more stimulating and the second, taken some five to ten minutes later, is the more astringent. Second brews should be avoided, for all the useful constituents of the tea are dissolved in the first brew. The physiological effects of tea are due to the stimulating influence of the caffeine on the higher centres of the brain. In moderation this is useful, but if taken in excess, toxic effects of caffeine may appear, such as irritability, insomnia, and tachycardia. In cardiac conditions and in hyperthyroidism, when the heart is already overstimulated, China tea is very much more suitable than either Indian or Ceylon. The effects of tannin have been much discussed. If the leaves have been stewed for a long time the tannin in the tea can be a cause of dyspepsia; but the widespread idea that tea should not be taken with meat on account of the hardening effect of tannin on the protein does not appear to be well founded, for it has never been suggested that tea should not be taken with fish or with eggs. If freshly brewed, the amount of tannin in tea is not harmful whatever other foods are taken at the same time.

Coffee. The coffee bean is obtained by pulping, drying, and finally milling the berry of the coffee plant. It contains less than half as much caffeine as tea, the same mineral salts, slightly less protein, and less tannic acid; but it has a little carbohydrate and fat. When the coffee bean is roasted the sugar it contains is changed into caramel and fragrant volatile oils are produced. Sixty to seventy per cent of the world's coffee comes from Brazil. Coffee is produced also in Arabia, Java, India, Kenya, and Costa Rica, but the best coffee the world produces comes from Sumatra. Coffee is often adulterated with chicory, obtained from the wild endive. There is no evidence that chicory is injurious to health but it is cheap and it has not the fragrance of coffee, nor has it the stimulating effects. Most of the 'coffee extracts' on the market have a high percentage of chicory and often some burnt sugar to give them a dark colour. The Calorie value of pure coffee is 89 per ounce in the dry state, whilst that of tea is only 17.

Cocoa. This is prepared by roasting and grinding the seeds of the

theobroma cacao, a plant that is indigenous to Mexico. Its fruit resembles a cucumber and embedded in its pulp are the seeds, which are about the size of a haricot bean. The bean itself contains about 50 per cent of fat, but a good deal of this is removed during the process of cocoa manufacture and is used as cocoa butter. Cocoa was first introduced into Europe in the sixteenth century, by the Spaniards, nearly a century before tea and coffee, although it has only been widely used as a beverage during the past century. Cocoa powder is almost insoluble. It is usually mixed with a starch, such as arrowroot, which increases its solubility. As sold, it contains about 10 per cent carbohydrate, 6 per cent protein, and 6·5 per cent fat. Its Calorie value is 126 to 130 per ounce in the dry state. Sodium and phosphorus are its chief salts and it also contains a little iron. Malted cocoa is a combination of cocoa with malt extract; for example, Bournvita consists of cocoa, malt, milk, and egg, its Calorie value being 180 per ounce. Malted cocoas have a lower Calorie value than pure cocoa.

Chocolate consists of ground cocoa nibs to which some of the fat removed during the process of preparation is returned, together with sugar, starch, and some flavouring agents. Unless adulterated, chocolate should melt quite easily. Ordinary breakfast chocolate has a Calorie value of 122 to 154 per ounce in the dry state. Eating chocolate has much the same food value, although some of the best makes have a Calorie value of 160 to the ounce; and as eating chocolate is usually taken in greater quantities than drinking chocolate it is obvious that as a food for overweight persons it should be taken very sparingly. The alkaloid in cocoa and chocolate is *theobromine*, but its amount is so small that its effects as a stimulant can be ignored. There are no vitamins in tea, coffee, or cocoa, although vitamins A and D are added to some makes of cocoa and chocolate and vitamins of the B complex may be present in the malted varieties.

CHAPTER 6

NORMAL DIETARY REQUIREMENTS

In order to arrange for satisfactory nutrition three considerations must be borne in mind: (1) The diet must supply the energy needed for the maintenance of all the functions of the body. This depends upon the combustion of carbohydrates and fats, which utilizes the oxygen carried by the blood from the lungs and produces two waste products—carbon dioxide and water vapour. (2) It must provide for the growth of tissues in the young and for the repair of tissues in the adult. For these processes protein food is essential. (3) It must be capable of promoting correct metabolism. Water, salts, and vitamins fulfil this role. In addition to these three main considerations, a diet should conform to the custom of the family, community, or race, and it must be governed by the availability of supplies and the economic status of the consumer.

For all practical purposes we consider carbohydrates as the energy producers, fats as the heat producers and proteins as the body builders. The more energy a person is expending, or the more heat he is losing, the greater his requirements of energy and heat-producing foods; and these requirements can be calculated. It is less easy to estimate correctly the amount of cell growth or destruction that is taking place in the body; and for this reason the proteins have to be assessed on their heat-producing value, for if their nitrogen is removed they also can be utilized for the production of heat and energy.

Heat production from foods is estimated in *kilocalories*—a unit introduced especially for the calculation of the heat liberated by the combustion of foods. It is defined as the amount of heat required to raise the temperature of one litre of water one degree Centigrade. It is also called the *large Calorie*, in contradistinction to the *small Calorie* used in physics, and it is considered correct to spell the former with a capital C and the latter with a small letter; although this distinction is not rigorously observed when the context is related entirely to foods. In estimating the energy, and therefore the heat, requirements

of an individual, provision must first be made for basal metabolism and then for the energy liberated by exercise and general acceleration of function.

METABOLISM

Metabolism is the term used to indicate all the chemical changes that take place in the living tissues of plants and animals. In human beings it includes the construction and repair of tissues, the storage of food substances in the body, the nutrition of all cells, the conversion of the chemical energy of absorbed food products into mechanical work as manifested in both voluntary and involuntary muscle contraction, the secretory functions of all glands, and the elimination of waste products from the body. Constructive metabolism, or building-up processes of the body and the storage of food, constitutes *anabolism*, whilst destructive metabolism, or the breaking down of body tissues or of food substances in the body, is known as *katabolism.* For perfect development and health anabolic and katabolic processes must be correctly balanced.

Basal metabolism is the minimum amount of metabolism that is consistent with the maintenance of essential life processes, such as respiration, circulation, glandular activity, and certain nerve functions. Such a basal state is reached from twelve to fourteen hours after the last meal, while the individual is comfortably warm and is at complete rest. Basal metabolism is in direct proportion to the surface area of the body. When the age, sex, height, and weight of a person is known, the normal basal metabolic rate can be determined by reference to charts first devised by E. F. du Bois as long ago as 1916, but revised by the same author in 1936. Under ordinary conditions the basal metabolic rate for an adult is remarkably constant, that for an average-sized man being 39 Calories per square metre of the body surface per hour, and for a woman about 36 Calories, on account of her smaller size. For a twenty-four-hour period the basal metabolic rate involves the expenditure of about 1,600 Calories. This must be made good by the food intake, and for all activity over and above the basal metabolic rate additional allowances must be made.

FACTORS INFLUENCING METABOLIC RATE

Physical activity. This is the factor that increases the rate of metabolism more than any other. The more work an individual does the greater the oxidation of food in his body to supply the necessary energy. Getting out of bed and dressing utilizes about 150 Calories, whilst walking on a level road at the rate of three miles an hour involves an expenditure of 1·1 Calories per hour per pound of body weight. Thus a man weighing 12 stone would expend 184·8 Calories in an hour's walk. An adult engaged in sedentary work expends 2,000 to 2,200 Calories daily; if engaged in moderately heavy work the expenditure is about 3,000 Calories, whereas in heavy manual labour 4,000 to 5,000 Calories may be utilized.

Age. In infancy, metabolism proceeds at a high rate but it shows a gradual decline from the second year until old age is reached. No one can estimate the exact Calorie requirements for an active child or an athletic young man, but for a healthy child or person in the prime of life appetite can be taken as a safe index of Calorie requirement, for there appears to be a regulatory mechanism that balances appetite against output and so maintains nutritional equilibrium. As age advances, this mechanism seems to become less reliable, and from middle age onward weight must be considered as the governing factor, the food intake being regulated by a conscious effort.

Ingestion of food. The taking of food, particularly of proteins, increases the metabolic rate. This acceleration of metabolism by food is known as the *specific dynamic action* of the food concerned, and it differs with the three classes of food. The intake of carbohydrate will increase metabolism by about 6 per cent and the intake of fat about 12 per cent. If the amount of protein consumed is so small that its amino-acids are used only for the replacement of worn-out tissue cells, or for the multiplication of cells in the growing individual, no specific dynamic action is exerted; but a high protein diet will cause a rise of 30 to 40 per cent in metabolism a few hours after the taking of a heavy protein meal.

Glandular secretions. The metabolism of the body is regulated, to a large extent, by the secretions of the endocrine glands, particularly the thyroid. Persons suffering from abnormally increased or decreased thyroid activity have a correspondingly raised or subnormal rate of metabolism, especially shown in basal metabolism.

REQUIREMENTS OF PROTEIN

Since the tissues of the body are constituted chiefly of protein and there is continual wear and tear of these structures a continuous supply of the amino-acids of which protein is constructed is essential. If protein is absent or deficient in the diet amino-acids are withdrawn from the less vital tissues, such as the muscles, and are used to supply the more important structures, such as the heart, the blood-vessel walls, and the brain. Nitrogen constitutes about 16 per cent of protein, in fact protein food is the only source of nitrogen available to the body. When the nitrogen intake of an adult is equal to his nitrogen excretion—by means of the urine and fæces—the condition is regarded as one of *nitrogen equilibrium*. If the nitrogen intake is greater than the output the individual is said to be in a state of *positive nitrogen balance*. This is the normal condition for growing children and for pregnant women, but it is present also during recovery from a wasting illness or a period of starvation, and a slight positive nitrogen balance may be present after a period of vigorous muscular activity; for in all these conditions more protein can be utilized as amino-acids than under ordinary conditions. Any excess of amino-acids over the amounts that can be utilized for body building are denitrified in the liver, the nitrogen being excreted in the urine—principally as urea—and the remaining oxygen, hydrogen, and carbon are used as fuel.

When the nitrogen intake is less than the nitrogen output the individual is said to be in *negative nitrogen balance*, and he must obviously be living, to some extent, upon his own tissues. The amount of protein in the diet must therefore be such that the nitrogen equilibrium in the body is maintained. In order to achieve this it has been estimated that a dietary intake of 80 to 100 grammes is required per day by the average man. This can be based on weight, allowing 1 gramme per kilogramme unless the person is more than 10 per cent over or under the normal weight for his age and height. The Calorie value of protein is 4·1 per gramme, so that 100 grammes will furnish 410 Calories.

REQUIREMENTS OF FAT

Digested and absorbed fats are either oxidized to give heat and energy or they are stored as fatty tissue, giving form to the body and

physical support to certain organs, particularly the kidneys. The amount required in the diet is subject to variations in climate. It is usually stated to be 80 to 100 grammes daily for an adult in this country. Fat has a very high Calorie value, yielding 9·3 Calories per gramme, so that the suggested quantities in the daily diet will provide from 744 to 930 Calories. In winter this amount might be increased, whilst in very hot weather even 80 grammes may be excessive.

REQUIREMENTS OF CARBOHYDRATE

As carbohydrate provides the chief source of energy for the body, it follows that foods required for all functions in excess of basal metabolism must be mainly carbohydrates, the amount needed being dependent upon the degree of expenditure of energy; and this varies enormously in different individuals. For a sedentary worker 250 grammes daily may be sufficient, whilst those engaged in heavy manual labour may need up to 1,000 grammes. The Calorie value of carbohydrate is 4·1 per gramme; so that 250 grammes will yield 1,025 Calories, whilst 1,000 grammes will yield 4,100 Calories. It is noticeable that the person who is hungry as a result of exercise in the open air will take thick slices of bread, with the same amount of butter as would be used on a thin slice, but will add jam, honey, or syrup if these carbohydrates are available. At dinner he will take larger helpings of potatoes and steamed or cereal puddings than does the indoor, sedentary worker.

PLANNING THE DIET

To be satisfactory, the normal diet must be well balanced, with due regard to the degree of energy that is being expended. It may include a wide range of foods. It may contain liberal amounts of meat or it may depend for its proteins on fish, eggs, cheese, and milk, whilst little or no meat is taken. It may be relatively high in fat or include only the minimum for essential requirements. A large quantity of vegetables may be provided or there may be a predominance of fruits. As wide a variety as possible should be chosen, for this makes the inclusion of other nutritive essentials—such as mineral salts and vitamins—much more likely to be adequate than when a monotonous diet is given.

It is not easy to arrange an adequate diet on a highly restricted

budget, but it can be accomplished, especially with the help that is now given with meals and extra milk at schools for the children of a family, and with the supplements that can be obtained at Food Offices. The most expensive foods on the market are by no means the most nutritious, and many of the cheaper varieties of fish, such as herrings and sprats, have higher food values than salmon, sole, or turbot. With regard to meat, cuts such as the best end of neck of mutton provide first-class protein and some fat. When the diet of the lower income groups is inadequate, the main deficiences are usually found to be in animal protein, for these are the most expensive articles, and in fats, fresh fruits, and green vegetables. Carbohydrates are seldom inadequate for they are among the cheaper foods.

The state of the market and the availability of foods must be taken into account when planning a dietary. This is specially true when scarcity of foods renders extensive rationing necessary; but those responsible for the rationing of foods are advised by experts in the knowledge of nutritional factors, and special concessions are made for people undergoing periods of physiological stress, as during the years when growth is rapid, throughout pregnancy and lactation, and in periods of ill-health. When the object is to secure an adequate diet at a low cost for a family it has been suggested that the expenditure should be planned so that one-fifth of the money should be spent on bread and cereals, one-fifth on meats, fish, and eggs, one-fifth on milk and cheese, one-fifth on vegetables and fruits, and the remaining fifth on fats, sugars, jams, other groceries and food adjuncts. Public Health workers are always ready to give advice on the best way to arrange the food budget for a family.

Not only the art of buying but the arts of cooking and serving are necessary in all catering. One should aim at planning meals that are good to look at, enjoyable to eat, and adequate in all nutritive essentials. Variety of flavour, contrasts of colour, texture, form, and temperature go far towards making a meal appetizing. A diet needs to be adapted to an individual's physique, and to living and working conditions. Short, stocky people usually absorb and utilize their foods much better than tall, slender people; and they tend to put on weight on a diet of lower Calorie value than that on which their tall, thin friends can retain a slender silhouette. City workers, who get little fresh air, sunlight or outdoor exercise, need less but more easily digested food than outdoor workers, and they often profit by being

given extra vitamins to make up for the sunshine they miss, to improve the functions of the alimentary tract, to stimulate appetite, and to increase stamina. They are prone to develop nervous strain and fatigue, and this interferes with secretory function and thus with appetite and digestion.

Breakfast of the hearty type, including porridge, a hot dish, with toast, bread and butter, marmalade or honey, and a beverage, is suitable for outdoor workers who usually have a very good appetite, can digest comparatively heavy foods with ease, and who expend a good deal of muscular energy in their work. The sedentary worker, on the other hand, finds such a breakfast unsuitable. He often prefers fruit—for its appetizing and laxative effects—some cereal or an egg dish, bread or toast, and a beverage; and such a breakfast is more adapted to his needs than the old-fashioned heavier meal. In the evening a half-hour's rest after the journey home will often relieve tenseness and fatigue and improve both appetite and digestion. A warm liquid, such as soup, and a little dry toast form a good beginning to a meal, for it stimulates the secretion of gastric juice so that the heavier course that follows arrives in the stomach when secretory activity is at its height. Salads and desserts require little digestion and sweet foods have a high satiety value—which is the reason why they are usually placed at the end of a menu.

SAMPLE DIET OF 2,275 CALORIES

Breakfast	*Calories*
Tea or coffee with milk—$\frac{1}{8}$ pint	50
Oats or cornflakes—1 oz.	100
Bacon—1 oz., or 1 egg. Margarine or butter—$\frac{1}{2}$ oz.	150
Bread—1$\frac{1}{2}$ oz.	100
Marmalade or honey—$\frac{1}{2}$ to 1 oz.	50
Sugar—2 lumps or 2 teaspoonfuls	50
	500
Mid-morning	
Tea or coffee with milk—$\frac{1}{8}$ oz., 2 biscuits	100

SAMPLE DIET OF 2,275 CALORIES—*contd.*

	Calories
Dinner	
Lean meat, fish or cheese	150
Fat meat or butter or margarine—$\frac{1}{4}$ oz.	50
Cabbage, cauliflower, sprouts, leeks or marrow, onions, lettuce, tomatoes or radishes	50
Potatoes—4 oz.	100
Bread—$\frac{3}{4}$ oz.	50
Rice, tapioca, or sago—$\frac{1}{2}$oz., or fruit	50
Milk—$\frac{1}{4}$ pint	100
	550
Tea	
Milk—$\frac{1}{8}$ pint in tea	50
Bread—3 oz.	200
Butter or margarine—$\frac{1}{4}$ oz.	50
Jam—1 oz.	75
Sugar—2 lumps, or 2 biscuits, or plain cake	50
	425
Supper	
Fish, cheese or meat	150
Potatoes—4 oz.	100
Vegetables as at dinner	50
Bread—$1\frac{1}{2}$ oz.	100
Butter or magarine—$\frac{1}{4}$ oz.	50
Fruit	50
Milk—$\frac{1}{8}$ pint in tea or coffee	50
	550
On retiring	
Milk—$\frac{1}{4}$ pint, 2 biscuits	150
Total Calories =	2,275

COMMUNAL FEEDING

The general development of communal feeding is the outcome of difficulties that were due to bombing, the call-up of women, and the shortage of domestic staff; but it has probably come to stay although the original necessity has ceased, with the exception of the domestic problems. Three main forms of communal feeding have the authority, and are worked under the direction, of Government bodies—school meals, factory canteens, and British Restaurants.

School meals. The billeting of children in areas outside the large cities and the employment of women in war industries created problems connected with the provision of mid-day meals for children. The education authorities therefore established school canteens on a wide scale, and by the end of 1941 nearly twice as many children received school meals than in 1939, and the numbers have steadily increased. School canteens now supply meals not only when it is difficult for the child to obtain a meal at home but to any children whose parents desire it. These meals may be free to those who cannot afford to pay, a minimum charge being made to those who can contribute something, whilst those parents whose incomes are adequate pay the full cost of the meal. The result is that a large number of parents avail themselves of the facility, especially as these meals are in addition to the standard rations.

Factory canteens. The provision of school meals ends when children leave school during the adolescent period, although the demands of rapid growth continue for some years longer. Under an order of 1940, all factories on war work that employed more than 250 people were compelled to provide a canteen in which hot meals were served. Most large organizations not on national work also instituted canteens, in fact many had done so before 1939. At the present time canteens are provided in practically all industrial and commercial organizations that employ sufficient people to make it practicable.

British Restaurants. During the winter of 1940–1 the Ministry of Food issued plans for these restaurants to local Food Offices. A year later there were 1,200 British Restaurants serving a daily average of 300 meals at a cost of 1s. each. There is a feeling, however, that even this small cost is more than many working adolescents can afford, and, in view of the increasing incidence of tuberculosis among this

age group, there is a suggestion that it should be reduced for all under 19 years of age.

The dinners were planned to supply one-third of the Calories and protein needed for the day and two-thirds of the vitamins. Actually, they seldom attain this standard although the average meal served does supply 900 to 1,000 Calories. Particularly is vitamin C liable to be at a minimum, for, although a green vegetable is usually supplied, the food is often kept hot for some time, or is reheated, with the result that most of the vitamin C is lost. This applies to all foods served in canteens, restaurants, and hotels; but if this fact is recognized and other foods are taken which compensate for the defect, the usefulness and general convenience of all forms of communal feeding may lead to an extended service that will ensure a better general standard of nutrition.

CALORIE VALUES OF SOME COMMON FOODS

Amounts required to furnish 50 Calories

Fresh Fruits

	ounces		*ounces*
Apples, raw	4½	Loganberries	10
Apricots	5½	Melon, with skin	12½
Bananas, without skin	2	Oranges, without peel or pips	4½
Blackberries	5½	Orange juice	4
Cherries	4	Peaches	4½
Cranberries	10	Pears	4½
Black currants	5½	Plums, raw, with stones	4½
Red currants	7	Fresh pineapple	3½
Gooseberries	4½	Raspberries	6¼
Black grapes	3	Strawberries	6¼
White grapes	2¾		

Dried Fruits

	ounces		*ounces*
Apricots	2¼	Peaches	¾
Currants	⅔	Prunes	1½
Dates, without stones	⅔	Sultanas	⅔
Figs	¾	Raisins	⅔

Vegetables

	ounces		*ounces*
Baked beans	1¾	Spring onions, raw	4½
Cooked broad beans	4	Parsnips, boiled	3
,, butter beans	1¾	Peas, fresh, boiled	3¼
Beetroot, boiled	3½	,, dried, boiled	1¾
Carrots, boiled	8¼	Potatoes, boiled	2
,, raw	7	Swedes, boiled	10
Leeks, boiled	7	Tomatoes	12½
Onions, boiled	12½	Lentils, before soaking	½

Cereal Products

	ounces		*ounces*
Arrowroot	½	Oatmeal	½
Bread	¾	Quaker oats	½
Cornflour	½	Rice	½
Cornflakes	½	Sago	½
Flour	½	Tapioca	½
Macaroni	½		

Meats

	ounces		*ounces*
Beef steak	¾	Mutton, roast leg	¾
,, sirloin	¾	,, stewed	½
Chicken	1	Pork, roast leg	½
Corned beef	¾	Rabbit, stewed	1
Duck	½	Tongue	⅔
Goose	½	Tripe, stewed	2
Ham, lean	¾	Turkey	1
Kidney	1½	Veal, roast	⅔
Liver, fried	⅔	Veal, roast fillet	¾
Mutton chop, lean, bone removed	2½		

CALORIE VALUES—*contd.*

Fish

	ounces		*ounces*
Bloater, with bone and skin	1	Mackerel, fried	1
Cod, steamed	2¼	Salmon, fresh	1
Haddock, fresh or smoked	1¾	,, tinned	1¼
Hake	1¾	Sardines	¾
Kipper, with bone and skin	1½	Skate, fried	¾
Sole or plaice	2	Whiting, steamed	2

Fats

	ounces		*ounces*
Butter or margarine	¼	Cream	½
Clotted cream	¼	Meat fat	¼

Other Quantities

Milk	400 Cal. per pint	Jam	75 Cal. per oz.
Egg	80 Cal. each	Marmalade	75 ,, ,, ,,
Fried bacon	150 Cal. per oz.	Sugar	20–5 per lump
Cheese	100 ,, ,, ,,	Plain biscuits	25 Cal. each
Custard powder	100 ,, ,, ,,	Bournvita	100 Cal. per oz.
Cocoa	140 ,, ,, ,,	Horlick's	100 ,, ,, ,,
Chocolate	150 ,, ,, ,,	Ovaltine	100 ,, ,, ,,
Golden syrup	100 ,, ,, ,,		

Tables giving the nutritive values of average servings of many common foods are given at the end of the book.

CHAPTER 7

DIET IN PREGNANCY AND LACTATION

Although pregnancy and lactation are normal physiological processes, they make definite demands upon the maternal metabolism that can only be met by an efficient dietary. If there had been nutritional defects before the pregnancy occurred, their results may be shown during the first half of the gestation period; but if the woman is well nourished her food requirements are not appreciably altered until about the sixteenth week. From that time onwards the demands of the developing fœtus render it imperative that additional food products shall be available to the mother, for not only does the fœtus gain in weight much more rapidly than during the earlier weeks but the maternal metabolism is gradually increased until about a few days before delivery. It has been estimated that, although by the last week in pregnancy the weight increase is only about 14 per cent, the increase in metabolism is about 23 per cent; which represents that of both the mother and the infant, so that the woman's Calorie requirement is about 20 per cent above her previous need. It should not only provide for the daily necessities but should afford a reserve to meet the demands of labour and the onset of lactation. Pre-natal diets in the past were often inadequate in Calories, and little provision was made for the increased requirements for calcium, protein, and several of the vitamins. The baby was probably smaller when the mother's diet had been inadequate, unless excessive amounts of carbohydrates had been ingested. Many young expectant mothers believe that the smaller the baby the easier the birth, but recent studies have shown that adequately nourished women have fewer complications during pregnancy and labour than inadequately nourished women, even though their babies are longer and heavier; and the general health of the babies is much superior to that of babies born to mothers whose diets have been poor during pregnancy.

As soon as pregnancy is diagnosed, some estimation of the woman's

nutritional status should be made, so that any existing malnutrition can be remedied. Reliance for adequate nutrition must be based upon foods themselves, but some concentrated nutrients may be needed, such as preparations of iron, calcium, and vitamins, together with a dietary increase in animal protein. When a pregnant woman is considerably overweight, being 10 per cent above the normal weight for her age and height, the cause should be investigated. It is usually found to be simple over-eating, and it is then necessary to revise the dietary intake to the normal requirement in order to establish a balanced metabolic mechanism during the pregnancy. In prescribing a reducing diet for a pregnant woman the possibility of limiting the fat, soluble vitamins to an undesirable level must not be overlooked.

PROTEIN REQUIREMENTS

Because new tissues are being formed the demand for protein is in a higher proportion than the need for carbohydrate and fat. Animal proteins, such as meat, fish, milk, eggs, cheese, and poultry, should form at least half of that taken during pregnancy, whereas at other times it is found satisfactory if a minimum of one-third of the dietary protein is from animal sources. Vegetable proteins are present chiefly in the gluten of wheat and in legumes. They form good accessories to animal proteins, but they do not contain all the necessary amino-acids—the end products of protein digestion. Amino-acids are used by the body for growth and for tissue repair. They pass through the placenta by diffusion and are used by the fœtus as tissue-building material. The protein intake during the later stages of pregnancy is believed to influence the quantity and quality of milk produced, and also to raise the fibrinogen and prothrombin content of the blood and so help to protect against excessive hæmorrhage during and following parturition. The chief end product of protein metabolism is urea, and its excretion is a function of the kidneys. The urine of the pregnant woman should be examined frequently during the second half of pregnancy, especially for the presence of albumen. If this should appear, it may be necessary to limit the amount of protein in the diet and to adjust the water and salt intake. A high protein diet was at one time thought to contribute to the incidence of eclampsia, but recent evidence appears to show that low protein diets are the more conducive to the toxæmias of pregnancy.

About one-sixth of the 2,500 Calories needed daily should be supplied by protein, which necessitates a daily intake of 100 grammes. A deficiency of protein in the diet of a pregnant woman will lead to the depletion of her own tissues to supply the fœtal needs. As a result the mother may develop anæmia, loss of muscle tone, nutritional œdema, and lowered resistance to infection. Lactation may be insufficient for the healthy growth and development of the infant after birth.

CARBOHYDRATE REQUIREMENTS

Carbohydrates are the essential source of physical energy, and they avoid the necessity for the combustion of proteins; but the energy requirements of the pregnant woman are not appreciably increased until the middle of pregnancy. If taken in excess of the body's needs, carbohydrate may be stored as fat, and any undesirable gain in the mother's weight or the development of an overweight baby may result in a difficult labour. Starches and sugars do not contain minerals or vitamins, so that if they form too great a proportion of the diet a correspondent deficiency in important minerals and vitamins may occur. The morning sickness that can often be so distressing in the early part of pregnancy may, however, be relieved by taking a small, simple carbohydrate meal, such as orange juice with toast or cream cracker biscuits, before rising.

FAT REQUIREMENTS

Especially during the early months, there should be no increase in the amount of fat taken by a pregnant woman, provided that the previous diet was adequate. An excess may lead to nausea and increase the tendency to morning sickness; but a deficiency may involve a lowered intake of the fat-soluble vitamins A, D, E, and K. It may be said, therefore, that no increase in a previously adequate intake is necessary during the first half of pregnancy, after which there may be additions in proportion to increases in other constituents so that fat provides about one-quarter of the Calories in the daily dietary.

MINERAL REQUIREMENTS

There is great need for calcium and for phosphorus in order that the bones of the fœtus shall be properly developed and the structure

of the teeth correctly laid down—for these are formed during the second half of intra-uterine life. The demands are increasingly greater towards the end of pregnancy, and if these are not met by dietary intake calcium may be absorbed from the mother's teeth, leading to dental caries, or even from her bones. Minor deficiencies of calcium may be the cause of cramps in the legs and arms, headache, and insomnia. An adequate intake of calcium is, however, unavailing unless vitamin D is present to aid its metabolism. Foods containing calcium also contain phosphorus, so that if the former is present in adequate quantities there is no danger of the latter being deficient.

The food with the highest calcium content is milk, and it may be noted that skimmed milk has the same calcium content as full cream milk, so that it may be taken instead of whole milk if it is undesirable to raise the total Calorie value of the dietary. Other good food sources of calcium are cheese, egg-yolk, almonds and Brazil nuts, green vegetables, fruit, cereals, sardines, and sprats. Calcium is also present in ordinary drinking water. It has been shown that the absorption of calcium is increased if the diet has a slightly alkaline balance, so that if citrus fruits are taken freely they will not only supply vitamin C but the citrus acid, being converted into a mild alkali during digestion, will promote calcium absorption.

Iron is needed for the formation of hæmoglobin and, therefore, the transportation of oxygen. Not only is there a growing demand for oxygen by the developing fœtus, but iron must be stored in its liver during pre-natal life in order to supply the needs of the infant between birth and the age at which it can take a mixed diet; for both human and cow's milk are deficient in this important mineral. Most of the storage takes place during the last third of pregnancy, and the liver of the average infant at birth is estimated to contain 246 milligrammes of iron, whilst the placenta contains about 500 milligrammes. In addition, the baby's hæmoglobin has a higher iron content than is normal at other ages. In the mother, if her dietary intake is insufficient to allow for this storage, an iron-deficiency anæmia may develop which, in turn, results in defective absorption from the intestines of the iron taken in food; much of it being excreted unchanged. The foods that are richest in iron are red meat, liver, egg-yolk, brown bread, spinach, watercress, nuts, and all fruits and vegetables that are rich in chlorophyll. Other necessary minerals, such as sodium, potassium, and sulphur, are usually present in adequate amounts in

any reasonably good diet. The amount of iodine necessary for normal metabolism during pregnancy should be found in an ordinary diet or in drinking water, especially if the diet contains fish or sea foods once or twice a week. In areas where the iodine content of the drinking water is low the deficiency may be overcome by the use of iodized salt.

VITAMIN REQUIREMENTS

The developing fœtus has need of all the vitamins and it cannot synthesize any for itself; consequently, the symptoms of mild vitamin deficiency in the mother manifest themselves more readily during pregnancy than under ordinary conditions.

Vitamin A is an essential growth factor, and clinical records suggest that a high content in the diet lowers the incidence of febrile puerperal conditions. The foods supplying this vitamin are milk, egg-yolk, cheese, butter, liver, and salmon. The yellow fruits and the green and yellow vegetables furnish its precursor, carotene, from which it can be synthesized in the body, probably in the liver. The Food and Nutritional Board of the National Research Council suggests that 2,500 to 3,000 I.U. of vitamin A are required each day by the average adult, but the pregnant woman requires 6,000. The new-born child is believed to need 200 I.U. and this requirement necessitates not only a larger storage during pregnancy but an increased intake during lactation.

Vitamin B. None of the vitamins in the B complex can be stored in the body. The standard allowance of aneurin (vitamin B_1) for adults under ordinary conditions is 300 to 500 I.U. daily. Approximately the same may be said of nicotinic acid, but riboflavin requirements are estimated to be less. These factors are necessary for promoting the growth of the fœtus as well as for maternal metabolism. Deficiencies of the vitamins in the B complex are probably manifested in the minor complaints of pregnancy, such as easy fatigue, loss of appetite, tachycardia, headache, dizziness, and emotional upsets; and it has been found that these symptoms are quickly relieved by the administration of preparations of the B complex. It has been authoritatively stated that the demands of pregnancy frequently bring to light latent B complex deficiencies to a point where they become minor clinical problems. The giving of vitamin B con-

centrates is a good therapeutic test to determine the adequacy of the dietary supply. Serious deficiencies are thought to predispose to abortion and to premature birth. The requirements for any individual are in distinct relation to Calorie intake, body weight, and urinary excretion. As these vitamins are water-soluble, they are readily excreted by the kidneys, so that the drinking of large quantities of water and a consequent rise in diuresis increase their loss from the body. It is possible, therefore, that some women will need a much greater intake than others. The three necessary vitamin factors are present, to a large extent, in the same foods, and a diet that is adequate in protein, milk, eggs, peas, beans, and whole-grain cereals will be almost certain to supply both the mother and the developing infant with optimum amounts.

Vitamin C is essential for the formation and health of many tissues, particularly the endothelial and connective tissues. Deficiencies are manifested in capillary walls, dentine of teeth, cartilage, and the matrices of bone; for the important function of vitamin C appears to be the control of cementing and intercellular tissue. Protracted morning sickness may lead to severe vitamin C deficiency and is itself helped by an increased intake. Marked deficiency may cause intrauterine death, or death of the infant shortly after birth from cerebral or other hæmorrhages; and it may predispose to excessive hæmorrhage during or after parturition. A daily intake of 100 milligrammes (2,000 I.U.) of vitamin C, or of synthetic ascorbic acid, throughout pregnancy will safeguard both mother and child from any symptoms of deficiency, the standard allowance for adults under ordinary conditions being 50 to 80 milligrammes. Citrus fruits, tomatoes, blackcurrants, rhubarb, swede, turnips, celery, onions, and raw green vegetables are the foods that are richest in vitamin C, but it must be remembered that cooking impairs or destroys it, according to the length of the cooking process and the presence or absence of alkalis. If low economic status or rationing conditions are responsible for a lack of citrus fruits in the diet, some equivalent source of ascorbic acid must be found. One pint of milk, three medium-sized potatoes, one teacup of raw cabbage, and one raw tomato will furnish 100 milligrammes of ascorbic acid.

Vitamin D is essential to the regulation of calcium and phosphorus metabolism, as has already been mentioned with regard to the necessity for adequate supplies of these minerals in the diet of a pregnant

woman. Few foods contain vitamin D. It is present only in cream, butter, cheese, fatty fish, and meat, egg-yolk, and liver; but it can be synthesized by the action of sunlight upon the skin—which is obviously the way in which human beings were intended to obtain their supplies of vitamin D. During the winter months and when living in cities the natural supplies can be reinforced by taking irradiated ergosterol or fish liver oil. The former supplies vitamin D only, but the latter supplies both vitamin D and vitamin A, and is issued free of charge to pregnant women from all Food Offices. A word of warning is necessary with regard to excessive intake of vitamin D, for whilst overdosage with any other vitamin will lead merely to a raised excretion in the urine without damage to any structure, a large overdosage with vitamin D may lead to an over-calcification of the fœtal cranium, preventing the moulding of the head during labour. The requirements of an adult under ordinary conditions are stated to be from 450 to 800 I.U. daily, according to the amount of sunlight to which she is exposed; but a pregnant woman should take 800 I.U. daily whether exposed to sunlight or not. It is suggested that the routine administration of cod liver oil or its equivalent in vitamin D potency to all pregnant women is a necessary safeguard, at least whilst the dietary sources are so strictly rationed in this country.

Vitamin K raises the level of prothrombin in the blood and so promotes coagulation. Thus it may lessen the tendency to hæmorrhagic complications in both mother and child during and after parturition. It is often given orally in its synthetic form—which is a derivative of naphthaquinone—during the last few days of pregnancy, or by intramuscular injection during labour. After long labours or instrumental deliveries it may also be given into the muscle of the new-born child. The shortening of coagulation time in the infant is regarded as of value in diminishing intracranial hæmorrhage, petechial bleeding, and other evidences of raised capillary permeability or of slow coagulation. There is normally a decrease in the maternal prothrombin level shortly after a birth, but this rises again towards the end of the first week. It has been found that the administration of barbiturate derivatives lowers the neonatal prothrombin level, so that especially when these analgesics are used the administration of vitamin K is indicated.

Vitamin E has been much discussed in relation to its influence upon

childbirth, but, although its absence from the diet of some laboratory animals leads to resorption of the fœtus, the claims made for it in preventing abortion in the human being have not been widely accepted. In abnormal maternity cases, such as those in which repeated abortion or premature labour has occurred, it has been given in an attempt to supplement the natural reproductive function. It has also been given to women in whom pregnancy has occurred after a long sterile period. Series of such cases have been reported in which a successful termination to pregnancy took place in a large proportion of these women. Two other factors, however, must not be ignored—the women were under medical supervision during the whole of their pregnancy and they were probably relieved of anxiety with regard to their capacity to carry their babies to full term. Vitamin E is found in such foods as wheat germ and whole grains, lettuce and other green leafy vegetables, and in meats. It is available in synthetic form as tocopherol.

MINISTRY OF FOOD PRIORITIES

Recognizing the great importance of an adequate diet during pregnancy, both to the mother and the developing child, every expectant mother is given an additional ration book which entitles her to one extra pint of milk daily, 50 per cent more meat and cheese and an extra allocation of both shell and dried eggs. In addition, orange juice is supplied by the local Food Office and so also is cod liver oil, which may be taken in liquid or in capsule form as preferred. It will be seen, therefore, that these extra rations supply all the additional factors that are of paramount importance in order to ensure the health of the mother and a good start in life for the infant.

MAINTAINING A WATER BALANCE

The fluid intake of a pregnant woman must be adjusted to prevent œdema, avoid a negative balance, and prevent dehydration. Sufficient fluids should be taken to ensure a urinary output of three pints daily. The relation of sodium chloride and water to the interchange of fluid in all tissue spaces must be borne in mind; for an impaired elimination of water or of sodium chloride, or an excessive intake of either, is always a contributory factor in œdema, and this is particularly true

during pregnancy. It has been estimated that 10 pounds of extra fluid may accumulate in the body tissues before clinical signs of œdema become manifest; so that the weight of a pregnant woman should be watched for any abnormal gain, for this is one of the early premonitory symptoms of toxæmia. When œdema occurs during pregnancy the woman must be examined for any signs of nephritis, or of nutritional œdema, and steps must be taken to ensure a normal water balance. It may be necessary to restrict both salt and water intake. In other cases a salt-poor diet must be given, prohibiting the taking of salt at table or of foods preserved by salting processes, and omitting the addition of salt in cooking. Sometimes the tendency to œdema can be eliminated by giving saline aperients, for these cause both catharsis and diuresis.

In the early months of pregnancy the loss of water and sodium chloride by excessive vomiting may lead to symptoms of dehydration. In persistent hyperemesis gravidarum it may be necessary to give physiological saline, with glucose and aneurin, by intravenous injection.

PLANNING THE DIETARY IN PREGNANCY

Two factors that operate to limit the absorption of food are vomiting in early pregnancy and displacement of the gastro-intestinal tract in late pregnancy; and these must be taken into consideration when planning the dietary. An optimum diet in the second half of pregnancy should include each day one quart of milk, one egg, one ounce of butter or of vitaminized margarine, one serving of meat, fish or poultry, one or two raw vegetables, one or two cooked vegetables, one serving of whole-grain or enriched cereal, fresh fruits such as orange, grapefruit or tomato, and six to eight glasses of water or its equivalent in tea and other beverages. Liver should be served at least once a week. A menu for one day might be arranged as follows:

Breakfast—One orange or half a grapefruit; oatmeal or whole-grain cereal; milk and sugar; bread or toast and butter; coffee or cocoa made with milk; poached or boiled egg, or fish.

Mid-morning—Glass of milk, with or without egg.

Dinner—Tomato juice; meat, fish or egg; potato, green vegetable; bread and butter; baked custard and fruit.

Tea—Tea with milk, and sugar if liked; bread, butter, and watercress.

Supper—Cream soup; macaroni with cheese; raw vegetable or nut salad; mayonnaise dressing; bread and butter; baked apple.

On retiring—Glass of milk, with Ovaltine or other flavouring if desired.

DIET IN LACTATION

The quantity and quality of milk secreted after the birth of an infant will be influenced by the mother's nutritional condition at the termination of her pregnancy, and also by her subsequent diet. A decrease in protein has an immediate and marked effect upon the milk. A decrease of carbohydrate is not apparent in milk secretion until the intake drops to 50 per cent of the normal requirements; whilst the intake of fat can fall even lower before its effect is seen in lactation; but the mother will draw on her own reserves and will lose weight. She will also lose energy, and the drain on her own health soon becomes obvious. Milk has a high content of calcium and phosphorus, and if the mother's diet is deficient in these minerals they will be extracted from her teeth and even from her bones to supply the needs of her infant. A lack of any vitamin in the dietary will result in a corresponding lack in the milk, and symptoms arising from the deficiency will inevitably develop in the infant. Especially do the vitamins of the B complex appear to be required in much larger quantities during lactation than at other times.

It has been estimated that a normal healthy baby will take daily between 2¼ and 2½ ounces of milk from its mother's breast for each pound of its weight. As the Calorie value of human milk is 20 to the ounce and a certain amount of extra metabolism is involved in the work of secretion, the mother's additional Calorie requirements are taken to be 60 per day for each pound of the baby's weight during the first three months of life. Thus a nursing mother with a baby nearing three months of age and weighing 10 pounds will require an additional 600 Calories daily. A pint of cow's milk will supply 400 Calories, with a good balance of protein and much of the extra calcium that the mother requires. Cheese, egg, meat, liver, and fish all supply protein; cheese is also rich in calcium; egg-yolk, meat, and liver in iron, and fish in phosphorus.

From the fourth to the end of the sixth month the baby has so added to its birth weight that 50 Calories per pound weight daily is considered to be sufficient addition to the nursing mother's dietary; for although a baby should double its birth weight in the first six months of its life, it merely trebles it by the end of the first year. It is important that the mother should drink about four pints of fluid daily in order to provide sufficient not only for her own requirements but also for the extra water needed for milk secretion; and unless the mother is taking an abundance of fresh fruit and leafy vegetables to ensure an ample amount of vitamin C in her milk, it is advisable to give the baby orange juice after the first month. Especially during the winter months, small quantities of cod liver oil should be given to amplify the amounts of vitamin D that the mother's milk can supply or the baby can make for himself as a result of lying out in the sunshine. Whole-grain cereals are the best sources of the vitamins in the B complex.

Fatty foods, fried foods, rich gravies and pastries, and all highly spiced and seasoned foods are to be avoided during lactation; for substances from these may be secreted in the milk and upset the baby's digestion. The mammary glands are very sensitive to nervous influences. Fatigue, worry, or excitement may cause a diminution of secretion, and so also may indigestion, constipation, or the taking of laxatives and other drugs.

GENERAL ARRANGEMENT OF THE DIETARY

Apart from the usual three meals each day, it is a good plan for the mother to take supplementary nourishment in the middle of the morning and the afternoon, and also at bedtime. The arrangement of the daily menu will depend upon what foods are available and the convenience of the mother. Articles such as marmalade and jam can be taken at any meal, as desired. The following suggestions are given as a guide with regard to the inclusion of suitable foods in the dietary:

Breakfast—This should include a cereal, whole-grain for preference. If grapefruit, orange, or other fruit rich in vitamin C is not available, tomato or a leafy vegetable might be substituted. The high-extraction bread at present supplied is preferable to white bread for its vitamin B content. Butter or national margarine supplies vitamins A and D. An egg or a serving of fish might be taken. Coffee or cocoa may be

preferable to tea because of the larger quantity of milk that may be utilized.

Mid-morning—A glass of milk or a flavoured milk drink should be taken unless the mother is taking the necessary amount of milk with other meals; in which case fruit or a fruit drink may be substituted.

Midday—A liberal serving of lean meat, fish, liver, poultry, or a cheese dish; potato and one other cooked vegetable or a raw vegetable salad. Desserts made of milk or fruit should be served as often as possible.

4 *to* 5 *p.m.*—Weak tea, with bread, butter, lettuce, or watercress; plain cake if desired.

Supper—Cream soup, followed by a dish made with egg, cheese, fish, or dried peas or beans, with cooked vegetables or a salad, according to what foods have been served earlier in the day.

At bedtime—A milk drink, if the prescribed quantity has not already been taken.

CHAPTER 8

THE FEEDING OF INFANTS AND YOUNG CHILDREN

Good nutrition during the whole of the period of pregnancy is the best foundation for lactation, and when the mother is healthy and well fed, complete breast feeding is unquestionably the best diet for the infant. It is cheaper, simpler, and cleaner than artificial feeding and the milk supplied by the mother contains all the necessary nutrients—with the exception of iron and vitamin D—in the form most easily managed by the baby's digestive tract and in the correct proportions for promoting health and growth. Moreover, the exercise afforded to the jaws, palate, and mouth and cheek muscles aid their development so that later on there will be room for the teeth to erupt without overcrowding. With all forms of artificial feeding the infant usually obtains the food with much less strenuous effort on his own behalf than with breast feeding, and there is danger of bacterial contamination of the food itself, the teats, the bottle or other container, and the utensils used; whereas the healthy mother's milk is sterile, so that the infant's liability to diarrhœa and other disturbances of the digestive tract is greatly lessened. Another advantage of breast feeding is that the milk as it comes from the breast is at the right temperature for the infant.

The secretion from the breast for the first few days after delivery is called colostrum. Its composition differs greatly from that of the milk that will be secreted later. It contains more protein and salts, but less fat and carbohydrate. The protein is chiefly in the form of globulin. Colostrum possesses a laxative property that helps to establish correct peristalsis and aids the expulsion of meconium—a dark green, viscid substance that forms the first fæces of the infant. The milk retains some of the characteristics of colostrum until almost the end of the second week after the birth.

ESTABLISHMENT OF BREAST FEEDING

In order to stimulate the secretion of milk the infant should be put to the breast, for about ten minutes, between four to six hours after delivery if the mother's condition is good. Thereafter he should be nursed at alternate breasts every four hours throughout the day. During the first few days he will obtain from 4 to 6 ounces of colostrum each day. At the 6 p.m. feed he may be allowed to nurse at both breasts, and then at 10 p.m. he may be given a supplementary feed of sterile water with 5 per cent glucose, which helps to counteract the loss of weight and the dehydration that tends to occur during the first few days of life. If considered necessary, this feed may be repeated once during the night. After the third day the baby will probably adjust himself to four-hourly feeding from 6 a.m. till 10 p.m. with nothing given during the night. He usually obtains all the milk there is in the breast during the first ten minutes, so that he should not be allowed to suck for more than fifteen minutes or he will swallow a considerable amount of air during the latter part of the time, which may give rise to fretfulness, colic, and vomiting. He will inevitably swallow some air, and it is wise to hold him over the shoulder for a few minutes after feeding, gently patting his back to assist in belching the air.

Some infants fail to gain in weight when four-hourly feeds are given, and often cry incessantly for an hour or so before a feed is due. These babies may do better if they are allowed to nurse at both breasts at each feeding, commencing with the right and left alternatively; or they may be fed at three-hourly intervals. The sucking of the infant stimulates the secretion of milk and thus enough may be produced to satisfy the baby's needs. In order to ascertain the amount of milk that the baby is withdrawing, he should be weighed before and after each feed. He can be weighed in his clothes, but taking care that no change occurs between the weighings—not even to the extent of changing a wet or soiled square. If the quantity of milk is insufficient or the baby fails to show a normal gain by the end of a week, he may be given a supplementary feed immediately after the breast feed. This may be of glucose and water, of humanized cow's milk, or of one of the proprietary dried milks that are prepared for the feeding of infants. One objection to the early use of bottle feeds is that the baby quickly learns that it is easier to obtain milk

from a bottle than from the breast and therefore he may become lazy in sucking from the breast.

REGULARITY OF FEEDING

An arbitrary feeding time-table was at one time rigidly advocated. It is less emphasized to-day, although the normally healthy baby will demand feeds at approximately four-hourly intervals, and some semblance of regularity is comfortable and convenient for the mother. A baby need not be wakened for a feed. He should be allowed to wake up naturally and be permitted to cry for some minutes in order to ensure that he is fully awake before being fed; but the intervals between feeds should not be less than three or more than six hours, except during the night, when an eight-hour interval is advisable. The consensus of modern opinion seems to be that a baby whose life is *not* set to a rigid time-table is apt to be happier and better-adjusted, and to have fewer digestive upsets than one whose life is ordered by the clock.

MIXED FEEDING

It may be found necessary to give some feeds in addition to those obtained from the breast. These may be complementary to the breast feeds and be given immediately afterwards, especially in the early period of lactation when an effort is being made to increase the supply from the breast; or a bottle feed may be substituted for a breast feed once a day. The giving of one bottle feed daily after the first month or two of life is thought to be advantageous in many cases, for it allows the mother to be away from home for longer periods and it facilitates weaning. From the beginning of the second month half a teaspoonful of cod liver oil and one teaspoonful of orange juice should be given daily, increasing to four times this quantity by the end of the seventh month.

ARTIFICIAL FEEDING

Cow's milk, either fluid, evaporated, or dried, forms the basis of most artificial feeds given to infants; but goat's milk and milk-free preparations may be used in those rare cases of milk allergy in infants. The composition of cow's milk differs from that of human milk in

that its protein content is twice and its mineral content three times as high, whilst its carbohydrate is rather less than two-thirds that of breast milk. Moreover, the type of protein is different, that of cow's milk being the rather coarse caseinogen that forms a dense curd with the rennin of the stomach, whilst that of human milk is the much finer lactalbumen which forms a light, flocculent curd with rennin; and for this reason a young baby is seldom able to digest undiluted cow's milk. The fat in cow's milk is practically equal in amount to that of human milk, but it is less finely divided and contains more volatile acids, and these sometimes irritate a baby's stomach.

The most usual modification of cow's milk for infant feeding takes the form of diluting it with an equal quantity of water, to reduce the proportion of protein, and adding sugar to make up the required amount of carbohydrate. When available, cream can be used to bring up the fat content to that of undiluted milk. In the absence of cream, cod liver oil can be used to supply fat. The boiling of milk not only sterilizes it but lowers the curd tension, making it more digestible; so that two-thirds milk with one-third water may then be found suitable. The disadvantage of boiling milk is that vitamin C is thereby destroyed and must then be supplied from other sources. Pasteurization of milk is another process that serves to render the curd rather more digestible, as well as to destroy bacteria. The addition of barley water, or of sodium citrate, prevents the caseinogen curd from forming dense, indigestible masses.

With regard to the best type of sugar to use, the baby's own reaction is usually a safe guide. Lactose may be too laxative and cane sugar too sweet. Maltose or dextrin-maltose mixtures are often found suitable, and are the types of sugar present in most proprietary infant foods.

EVAPORATED OR DRIED MILKS

Those specially prepared for infant feeding are the obvious brands to use. The methods of preparing them for the market include sterilization, and the processes often render them more digestible than cow's milk in the raw state. Instructions with regard to dilution, the addition of sugar, and the necessity for additional substances, such as fruit juice and cod liver oil, to supply adequate vitamins, are also printed on the containers.

THE PREPARATION OF INFANTS' FEEDS

The total quantity needed for the twenty-four hours should be prepared at one time. The utensils required should be thoroughly washed and then boiled before use. If possible, five feeding bottles should be available. The total Calorie value should be 50 per day for each pound of the infant's weight; but in feeding undernourished or underweight babies the amounts for the weight normal for their age rather than their actual weight should be given, if it is possible for the babies to take it. The total quantity should not be more than 35 ounces in twenty-four hours, even for a baby in his ninth month. If fresh milk is used, the specified quantities of milk and water should be boiled over a low flame for three minutes; sugar is then added and the feeds are poured into the bottles, which are cooled quickly by standing them in cold water. They should then be placed in a refrigerator or other cool place until required for use. When evaporated or dried milks are used, only the water needed for the feeds should be boiled, but the rest of the procedure should be the same as when preparing feeds with fresh cow's milk. As each feed becomes due, a bottle is placed in hot water for a few minutes to raise the temperature of the milk approximately to blood heat. In giving the feed, the bottle should be held at such an angle that the baby does not suck air, and not more than fifteen minutes should be taken over each feed.

ADDITIONAL FEEDINGS

Whether the baby is breast-fed or artificially fed, by the time he has reached his fifth month cereal gruels may be gradually introduced into his feeds, or be given by spoon before the feed. Some of the prepared cereals that are obtainable are fortified with iron and with the vitamins in the B complex, both of which are desirable additions to the feeds at this age. A month or so later vegetable juices or purées can be given before one feed each day, and from the seventh to the ninth month egg-yolk and the pulp of cooked fruits may be given. These additions help to supply the extra minerals and vitamins that the baby requires, and egg-yolk also supplies iron. When the baby has teeth he may be given crusty bread or toast to chew.

WEANING

It is usually advisable to wean a breast-fed baby gradually. The introduction of additional foods from the fifth month onward commences this process. By the ninth month the baby's capacity to digest cooked starches is established, and this makes it possible to give him bread, potatoes, rusks, or thoroughly cooked cereal from one to three times a day. During the early months of life, when the natural food of the baby should contain no starch, the enzyme of the saliva—ptyalin—is deficient; but it develops during the early teething period. Starchy foods taken before that time must rely upon the pancreatic amylase for hydrolysis into complex sugar, so that it is inadvisable to give more than a minimum amount of starch until it can be dealt with adequately.

Rusks, crusty bread, toast, or raw apple give exercise in chewing and help both muscular development and the flow of saliva. The pulp of raw or cooked fruits, such as orange, apple, banana, or prunes, and mashed green vegetables or carrots, helps to prevent constipation as well as to furnish extra minerals and vitamins. Well-cooked ground liver or other meats and egg-yolk are good sources of iron; but whole egg is not usually given until the second year of life. The baby still requires at least one pint of milk daily and he should learn to take it from a cup rather than from a feeding bottle or a spoon.

DIET IN THE SECOND YEAR

The basic daily diet should now include a pint and a half of milk, one egg or a serving of pounded meat or fish, well-cooked rice or other cereal, several vegetables, fruits, bread, butter, and from 4 to 6 ounces of citrus fruit or tomato juice and one to two teaspoonfuls of cod liver oil. The diet may be varied, but all very sweet or seasoned foods should be avoided. Custards, junket, simple boiled puddings and desserts are gradually allowed. Neither fruits nor vegetables need now be puréed, but they should be cut into small pieces with seeds, stones, or tough skins removed. Whole eggs may be given after fifteen months; and from this age the baby should be encouraged to feed himself, though at first much of the food may be wasted in his efforts to convey it into his mouth. He should have mastered the art by the end of the second year.

Quantities should be increased as the child grows, but the appetite of a normal, healthy child is the best guide as to the amount of food required at any particular age. Only the wholesome, easily digested foods such as those mentioned above should be given. The introduction of new foods which require considerable digestion should be tentative, especially during hot weather.

If the food is adequate, the gain in weight during the second year of life will average 7 ounces a month, which gives a total gain of 5¼ pounds in the year; the appetite is good, the muscles firm, the bones straight, and the skin clear and of a good colour. The child is active whilst awake but sleeps easily for a few hours during the afternoon and uninterruptedly throughout the night. He cries but seldom and has no intestinal upsets, such as vomiting, diarrhœa, or constipation.

DIET BETWEEN THE SECOND AND FIFTH YEARS OF AGE

This is the period when dental defects, enlarged tonsils and adenoids or malformations of bones may first make their appearance if a diet is inadequate. They may be prevented by providing toddlers with sufficient milk, eggs, butter, meat, fresh fruit, and green vegetables, and by limiting the intake of bread, cereals, and sweets. Growth is rapid, and demands a higher proportion of protein, mineral salts, and vitamins than is considered adequate in the diet of adults. Children require 15 per cent of their total Calories to be supplied by protein of good biological value, whereas for adults 10 per cent is sufficient.

Children must be trained during this period in the right habits of eating, such as chewing their food well, neither hurrying nor dallying at meals, nor taking large quantities of liquid that distend the stomach and destroy appetite. Eating between meals should not be allowed. It is wise to allow a definite time for the taking of meals, and then to remove what is left without comment; for the child will probably make up for any deficit in quantity at the next meal. When the diet is sufficiently varied he will eat enough during each day to satisfy his requirements; but he should never be forced, cajoled, or bribed into eating the foods he dislikes, even though they are good for him. If there is a fairly wide selection of foods a child usually chooses a well-balanced diet. When an important article of food is disliked, it sometimes helps if it is mixed with some other food that

the child enjoys and he may then overcome his dislike quite easily. Very often, difficulties in feeding children have their origin in the attitude of the older members of the family. Parental over-anxiety at meal times is often the cause of a child's refusal to take food, but it is quite normal for a child to take a very small quantity at one meal and then to eat almost twice the usual quantity at the next. It should be remembered that nervousness and excitement at meal times may destroy appetite and interfere with digestion, and therefore when a child is being prepared for a meal is never the time to scold him for his misdeeds during the day, nor should family problems be discussed in the presence of the child with any degree of heat or emotion.

Suitable intervals for the three chief meals of the day might be arranged by giving them at 7 a.m., 1.30 p.m., and 5.30 p.m., with a glass of milk and a biscuit at mid-morning.

CHAPTER 9

DIET IN THE AGED

After middle life men and women should be able to make their greatest contribution to the good of humanity on account of their experience. Unfortunately, the period between full physical, mental, and emotional maturity and senescence is apt to be short. Senescent changes include an atrophic thinning of the intervertebral disks leading to a loss of flexibility in the spine, a certain degree of stooping, and a change in the shape of the bony thorax which favours the development of postural emphysema. The rising mineralization of bones increases the liability to fractures. Loss of teeth and a diminution of salivary and gastric secretion interferes with digestion, and atrophic changes in the gastro-intestinal musculature and mucosa may lead to flatulent distension, constipation, or bouts of diarrhœa. The blood-vessels tend to become hardened and there is a rise in blood-pressure. Metabolism is reduced from 10 to 30 per cent as age advances and, at the same time activity is lessened. These changes are inevitable but they need not lead to senility—which involves mental and emotional deterioration as well as physical changes. One of the greatest single factors in delaying the approach of senility is the adoption of a suitable diet. A total intake of from 1,200 to 2,000 Calories a day may be sufficient; but the foods must be carefully chosen and must contain good proteins and adequate minerals and vitamins, for these are the factors so often found to be deficient when a limited quantity of food is taken.

SPECIAL DIFFICULTIES IN FEEDING THE AGED

The majority of old people have artificial dentures and, owing to the changes that occur in the shape of the jaws as age advances, these may be ill-fitting and so interfere with mastication, or even cause ulcers in the mouth and so make mastication a painful process. As a result of uncomfortable dentures, old people will often refuse to eat

meats or the coarser vegetables, restricting their diet largely to plain, starchy foods. In addition, they often have fixed ideas with regard to the foods that they like or dislike and those that do or do not agree with them, so that they tend to limit their selection of foods. It is seldom that an aged person takes too much food and the problem of obesity is not often present, for the obese person and those that habitually over-eat seldom live to real old age. The difficulty often lies in getting an old person to eat sufficient for his needs.

DIETARY NEEDS IN OLD AGE: PROTEIN

No new tissues are being built and there is no great tissue loss such as occurs in the young and vigorous; but protein is necessary to keep the tissues in a healthy condition and to maintain a nitrogen equilibrium. Traditionally, protein has been condemned in the diet of the aged because of its alleged harmfulness to the kidneys and, to a lesser extent, to the vascular system. But medical opinion has changed in this respect in the last few years. Animal proteins are now recommended, for they not only contain all the necessary amino-acids but the iron content of meat and eggs is relatively high, and this helps to counteract the tendency of the aged to develop a hypochromic, microcytic anæmia with a low red blood-cell count. A diet deficient in protein may cause a nutritional œdema in which there is a reduction of plasma proteins that leads to an abnormal osmosis of fluid from the blood-vessels into the tissues. Only when there is a marked arteriosclerosis with a high level of nitrogenous waste products in the blood is it recommended that restricted amounts of animal protein should be given.

CARBOHYDRATE

Bread, potatoes, and cooked cereals are often the easiest foods for old people to consume, and they may be very fond of sweet things. There is usually no need to restrict carbohydrates provided that they are not taken to the exclusion of protein; but those carbohydrate foods with a high mineral and vitamin content should be chosen. For example, whole-wheat bread, oatmeal porridge instead of refined breakfast foods, and vegetables that have undergone the minimum cooking in a small quantity of water are the best carbohydrates to

give; whilst it should be remembered that sugar contains neither minerals nor vitamins.

FATS

The digestion of fat is more difficult than that of carbohydrate, and a high intake may lead to gastro-intestinal disturbance and to obesity; so that in the diet of the aged the proportion of fat to other constituents should be less than for younger people. The fat of milk and the phosphorized fat of egg-yolk are, however, easily digested fats. The same can be said of butter and cheese which, after all, are milk products. Fried foods are not suitable for the aged, for the fatty covering needs to be digested before the digestion of the covered substances can begin, and, seeing that fat is not digested until it reaches the duodenum, a good deal of gastric digestion is missed.

MINERALS

It has been suggested that the calcium intake should be reduced to a minimum in the diet of the aged because of the tendency to hardened bones, joints, and arteries; but controlled experiments have not shown this restriction to be advantageous. It is believed that a normal calcium intake is desirable and that an old person should take one pint of milk daily—this being the food with the highest calcium content. It should not be forgotten that cheese is also rich in calcium. Other minerals that are apt to be deficient in the diet of the aged are iron and iodine. The former can be supplied by meat, liver, leafy vegetables, and eggs. Iodine is necessary for thyroid function and, as myxœdematous symptoms are prone to develop in old age whilst thyrotoxicosis is rare, it is advisable to ensure that there is no lack of iodine in the diet. It is present in drinking water, in sea foods such as shrimps, fresh salmon, oysters, crab, and lobsters, although the last two are somewhat indigestible foods for old people. Green peas and beans contain small amounts of iodine.

VITAMINS

A consideration of the vitamin content in the diet of the aged is of much greater importance than that of the mineral intake, for it is

very common to find vitamin deficiencies in old people, notably of vitamin C and the vitamins of the B complex. The very fact that old people tend to limit their dietaries to a comparatively few foodstuffs and to take only small quantities favours a deficient vitamin intake, and many of the smaller physical disabilities of the aged can be greatly helped by remedying this deficiency. Digestive disorders, nervousness, irritability and many ill-defined aches and pains may often be relieved by increasing the intake of aneurin, riboflavin, and nicotinic acid; whilst the spongy, bleeding gums and tender muscles from which the old person may suffer are usually indications of vitamin C deficiency and can be helped by giving ascorbic acid. Watery eyes, ocular fatigue, and chronic conjunctivitis may be due to lack of vitamins, especially vitamin A. Undoubtedly the best sources of vitamins are foods and these are always preferable to chemical preparations. Only occasionally is it found necessary to supplement a well-selected diet with laboratory-prepared vitamin products, for if adequate amounts of meat, vegetables, fruit, milk, and butter are taken daily the mineral and vitamin requirements of the aged are usually satisfactorily met.

FLUIDS

Although water is not a food it is absolutely essential that a sufficient quantity should be taken each day to counteract the fluid loss by the skin, the lungs, and the excretory organs. At least three pints are necessary each day. These can be taken as plain water, carbonated waters, milk, tea, coffee, cocoa, or alcoholic beverages, provided that the last named are taken in moderation. In the elderly, tea is less likely to cause indigestion than is coffee, but both are mildly diuretic and they contain xanthine, which is a stimulant to coronary circulation.

GENERAL PREPARATION AND ARRANGEMENT OF DIET

Owing to the slower digestive processes in the aged it is usually found to be desirable to give the largest meal at midday rather than in the evening, and to give a light supper several hours before bedtime. All foods should be simply but attractively prepared. If loss of teeth renders mastication difficult, well-cooked cereals, fruits, and

vegetables will be appreciated, but crisp toast might be managed quite well. Meat can be minced and other solid foods chopped fine. Hot foods are usually welcomed and a hot drink or a meat broth taken at the beginning of a meal helps digestion by stimulating the flow of gastric juice. It is advisable to give small meals at the usual intervals, but to give some light nourishment, such as clear broth, fruit or fruit juices, hot milk with Ovaltine or flavoured with coffee or cocoa, malted milk or a cup of tea between the main meals. Unless they are overweight, old people should receive at least sufficient to maintain their weight for their age, sex, and height. They should be encouraged to take moderate exercise according to their capacity, but to take a short period of rest after each meal; and to maintain a broad interest in other people and in current affairs, for a completely self-centred old person is very difficult to feed.

CHAPTER 10

METHODS OF PRESERVING FOOD

All foods are organic substances which, in their natural state, contain bacteria. These bacteria multiply rapidly, especially in moist foods, and they bring about the changes associated with fermentation and putrefaction. During these processes toxins are produced which are poisonous to human beings. In addition to bacteria, certain moulds and yeasts grow abundantly in foods and render them unfit for consumption.

The necessity for, and therefore the methods of, preserving foodstuffs developed as large proportions of the population tended to congregate in cities at some distance from the source of their food supplies; for the time required for the packing and transportation of fresh foods became too great to ensure that these foods would be in a condition to eat when the consumer obtained them. Often, they must be stored at their place of production for local use at a later date. The attempted food blockade in the recent war, with the inevitable increase in transport difficulties, magnified the pre-existing problems connected with food preservation; but eventually resulted in an extension of the methods previously used, and their application to a wider range of food products.

In order to preserve foods, either the bacteria in them must be killed and others prevented from gaining access, or the foods must be kept under such conditions of temperature and dryness that bacteria cannot multiply in them. The principal methods used to achieve these ends are:

1. Cold, at a temperature either very slightly above or considerably below freezing point.
2. Gas storage.
3. Heat, with subsequent exclusion of air.
4. Smoking, salting, and pickling.
5. Glazing.
6. Drying, by exposure to the sun or to artificial heat.
7. The addition of chemical preservatives.

COLD

When food has to be transported from distant countries and often through tropical zones, cold storage is an invaluable method of preventing decomposition, especially for meat or fish. These foods may be 'chilled' or 'frozen'. Chilled meat is maintained at a temperature of 28° to 30° F., and it will keep at this temperature for as long as three weeks. The fat becomes pinkish instead of white or pale yellow as in freshly killed meat, and this change affords a means of recognizing that meat has been chilled. It retains its flavour better than frozen meat, but during storage it may be attacked by certain moulds and yeasts that cause such conditions as 'black spot' and 'white spot' which, although not rendering the meat poisonous, lead to economic loss. To obviate the growth of these fungi, strict cleanliness in the slaughter-house and packing-rooms is essential. Ventilation should be good, for air stagnation and humidity accelerate the growth of all moulds and yeasts.

Frozen meat is kept at a temperature below 20° F., and unless it is allowed to thaw it will remain wholesome for as long as three years. When thawed, it can be recognized by the fact that the flesh is darker and more moist than that of fresh meat and the fat is stained by the meat juices. Fish frozen in brine at 4° F. will keep for three months. Cold storage consists of three stages—freezing, storage in the frozen state, and thawing. The low temperature required for freezing is produced by the cooling of brine as the result of the rapid evaporation of liquid ammonia, carbon dioxide, or chlormethane. Brine freezes at a very low temperature, the cold brine being circulated in pipes within the freezing chamber. The frozen food is then stored in an insulated chamber at the required degree below freezing point, for each class of food an optimum temperature being used. Packing in ice will reduce the temperature to freezing point but not below it; this method is useful for many fruits. Fruits that do not stand transport well, such as strawberries and raspberries, will remain in good condition for a longer period if they are cooled to 40° F. immediately after being gathered; but cold has a somewhat limited application in the preservation of both fruits and vegetables.

Household refrigerators generally use electricity to vaporize liquid ammonia which is flowing in coils within the food container. The heat required for vaporization is taken from the air in contact with

the food, which is thereby cooled. The gaseous ammonia then condenses in other coils, after which it is ready to be vaporized again. There is a vacuum between the food container and the exterior wall of the refrigerator. Cooked food should be allowed to cool before being placed in a refrigerator, and foods having a strong odour should be kept in covered dishes. The cleanliness of the refrigerator itself is important. Several times a week the food should be taken out, the shelves removed, washed, and dried ready for replacement and the inside should be washed with a cloth wrung out of soda water; spots and stains being removed with a fine abrasive. If a drainage pan forms part of the equipment this must be emptied and cleansed.

GAS STORAGE

It has been found that carbon dioxide has a preservative action upon certain foods. Chilled meat can be kept in a good condition for ten weeks in an atmosphere moderately charged with carbon dioxide if the temperature is maintained at freezing point. Apples can be stored in an unheated loft or barn if packed in a container with a concentration of carbon dioxide as low as 15 per cent. In the transportation of ice cream from factories carbon dioxide 'snow' is used, but the anti-bacterial effect of this procedure is probably due in a much greater degree to the intense cold than to the carbon dioxide itself. Eggs can be preserved in an oxygen-free atmosphere containing 80 per cent of carbon dioxide if the temperature is kept at freezing point. Ethylene gas (C_2H_4) is often used for unripe fruits, for it will preserve and ripen them. Green bananas are often transported in a chamber filled with ethylene. Grapes and oranges may be packed in iodized wrappers, for the iodine vapour given off retards decomposition.

HEAT, WITH SUBSEQUENT EXCLUSION OF AIR

Apart from the pasteurization of milk and the boiling of fruits with sugar in jam-making, heat is used more in the canning of meat and fish than in any other form of food preservation, although the canning of vegetables and fruit has developed into a rapidly growing industry during the past few years.

Canning of meat or fish. It is essential that the food to be canned

shall be thoroughly sound, and all carcasses must be examined after slaughter by a qualified Food Inspector before the process of canning can commence. The bones are removed and the food is partially cooked in order to produce shrinkage. The tins are filled, weighed, and capped. Two methods of exhausting the air are in general use. With the first, a small hole is made in the lid and the tins pass into an air exhaust chamber whilst the contents are still cold. The puncture is then closed in a vacuum-sealing machine. With the second method, the tins are heated, a puncture is made to allow hot air and steam to escape, after which the hole is immediately soldered. With both methods a negative pressure is produced, so that the ends of the tin may become slightly concave after closing. The tins are then heated in an autoclave to a temperature of 240° to 250° F. and maintained at this temperature for twenty minutes in order to sterilize the contents, for if any bacteria were left they would multiply and decompose the food, producing gases which would cause a bulge to appear on the end of the tin. When removed from the autoclave the tins are rapidly cooled, and they may be re-lacquered on the outside to prevent corrosion. Samples from each canning batch are sent to a laboratory where they are kept at a temperature of 98° to 100° F. for a fortnight, and then the contents are examined in order to ascertain that no organisms are present that could multiply at blood temperature. 'Blown' tins must always be discarded. When canned food comes from abroad it is examined at all ports of entry into the United Kingdom by Food Inspectors, and samples are taken for examination before a consignment is passed.

Other methods of using heat. Foods may be preserved in glass containers—ox tongue and meat or fish pastes are usually put up in this way, and so are many fruits. Toughened glass is used and the container is closed by means of a lacquered tin cap lined with cardboard or waxed paper. After the air is exhausted a rubber gasket helps to maintain the air-tight seal and the cap is either screwed on or is reinforced and held in position by a metal collar.

The usual 'home' method of bottling fruit follows the same lines, but the vacuum is effected by the cooling of boiling water. The jars are filled with fruit and are placed on a shelf in the oven until the contents become quite hot and 'sweating'. Then as each jar is removed it is completely filled with boiling water and a cap is immediately screwed or clamped on, using a rubber rim to ensure a

tight seal. As the water contracts on cooling, a partial vacuum is produced above it. It is important that the water should have boiled for twenty minutes so as to ensure that it is quite sterile.

The boiling of fruits with sugar is the basis of the procedures in making jams and jellies, and a high degree of preservation is thus effected. In crystallization, fruits are sterilized and are then dipped into a crystalizing preparation of sugar and water.

SMOKING AND SALTING

These methods are often used in conjunction, and chiefly for fish, pork, and bacon. The food may be soaked in brine before being smoked. Preservation by smoking is due, mainly, to the penetration of food by compounds present in the smoke produced by the burning of oak or beechwood chips, or sawdust. These woods give off a tarry smoke rich in cresols—the most valuable of the smoke compounds for the purpose of food preservation—which are deposited on the meat or fish, and, being absorbed, have an antiseptic action upon bacteria. When meat or fish is to be salted only, it is immersed in an 18 to 25 per cent solution.

PICKLING

This is a method used for red cabbage, gherkins, onions, cauliflower, cucumber, and marrow, and also for walnuts. Vegetables, with the exception of onions, are cut in slices, or shredded, and are soaked in brine made with two pints of water to a pound of salt for three days, after which they are washed, drained, put into jars and covered with hot vinegar flavoured with spices. Onions are pickled whole and are not previously soaked in brine. Walnuts are also pickled whole, the brine in which they are soaked being half the strength of that used for vegetables and it is changed each day. The walnuts are then drained and left on flat dishes until they are quite black before being placed in jars and covered with hot pickling vinegar. Sweet pickles may be made with plums and other fruit.

GLAZING

This is used chiefly for eggs. Its object is to render the shell non-porous to both air and bacteria. It must first be ascertained that the

shells are undamaged, for if they are chipped or cracked it is useless to try to preserve them. The eggs are immersed in waterglass, which is an aqueous solution of sodium silicate.

DRYING, OR DESICCATION

This preserves food by removing the moisture that is necessary for bacterial growth. The process may be 'complete' or 'partial'. Fruits usually retain about 6 per cent of their moisture, the preservation being aided by the sugar contained in the fruit. Water is replaced in the dried fruits by soaking them in water for some time before they are cooked or otherwise prepared for the table. Some foods, for example, raisins, are sun-dried.

Milk is completely dried and bacteria are destroyed by one of two processes:

(a) *The roller process.* The milk is slowly poured on to the surfaces of two metal cylinders placed not more than two millimetres apart. The milk collects in the gap between them and is carried round on the rollers at a temperature just below boiling point until it comes into contact with two knife edges which scrape off the flakes of dried milk. The flakes are then pounded and are packed in tins. The antiscorbutic vitamin is destroyed by this process, the vitamin A content is lowered, but vitamins B complex and D are said to be unimpaired. Eggs are dried by the same method.

(b) *The spray process.* The milk is first concentrated in a vacuum pan at 156° F. to about half its bulk. It is then sprayed into a tin-lined chamber into which a current of air at a temperature of 240° F. is admitted. The droplets from the milk spray are immediately dried by the heat and fall on the floor of the chamber as a fine powder, which is then collected, sifted, and packed.

Dried milks and eggs keep almost indefinitely if placed in air-tight tins, but no preservative is allowed to be added. They are portable and very easy to use. Dehydration processes have been employed during the past few years for almost every type of food in order to economize in shipping space and to facilitate transport generally; and new methods are still being introduced.

PART II

DIET THERAPY

CHAPTER 11

ROUTINE HOSPITAL DIETS

ROUTINE HOSPITAL DIETS

In all hospitals the diets planned for the patients are in four categories: (1) Fluid diet, (2) Light diet, (3) Full diet, (4) Special diets. The first three are routine, or standard, diets, and they form the basis upon which food is ordered by the ward sister. The special diets are modifications to meet specific pathological, functional, or metabolic conditions. They may be adapted from a standard diet or they may need to follow a detailed prescription so accurately that their preparation becomes the work of a trained dietitian and their effectiveness may need to be checked by laboratory tests.

The patients, therefore, fall naturally into two groups—those who may be given routine diets and those whose diet forms part of their specific medical treatment and must be individually prescribed.

FLUID DIET

This may be (*a*) milk diet, when several pints of milk are allowed each day; or (*b*) liquid diet, which may include soups, broths, gruels, and other beverages in addition to milk.

ARRANGING A MILK DIET

Many patients are not fond of milk or are unused to drinking much of it at any time. Indeed, with the very restricted milk rationing that has been necessary for some years past it has been impossible for the ordinary citizen to use it as a beverage; but even those who could occasionally enjoy a glass of milk would become nauseated if it were offered to them every two hours as the only allowable form of nourishment. To induce a patient to take three or four pints daily, and to enjoy it, needs thoughtful planning and preparation in order to present it in many different forms and with various flavourings.

The quantity of milk that a ward sister is expected to order daily for a patient on a milk diet is three pints. Milk contains most of the necessary food elements but it is deficient in iron—the lack of which is a cause of anæmia—and some of its vitamins may become impaired during the preparation of the feeds. Then again, the Calorie value of milk being 400 to the pint, it will readily be seen that the 1,200 Calories yielded by three pints need to be augmented to meet even the basal metabolic requirements. Another point to remember is that milk is a food in which gas-forming bacteria multiply rapidly in the alimentary tract. For this reason its use as the main form of food may be contra-indicated, or the patient may be allowed a carminative such as peppermint or ginger in order to avoid flatulent distension. Many hospitals use a fortified milk mixture which gives about 700–750 Calories to the pint. Directions for its preparations are given on p. 277.

Patients on a milk diet are usually allowed Benger's Food, Horlicks' malted milk, Ovaltine, tea, coffee, or cocoa; and all these can be made entirely with milk when the object is to increase the intake of nourishment. Many patients like sweet drinks, so that sugar may be added and this also reinforces the Calorie value of the feeds. As a change from sweet drinks, an occasional feed may be flavoured with cinnamon or other spice, or the consistency can be varied by giving a milk jelly with a fruit flavouring and colouring. Variety can also be introduced by giving some foods hot and others cold or iced. With regard to quantity, a patient can usually take 8 to 10 ounces every two hours. An ordinary breakfast-cup or tumbler filled to within half an inch of the brim holds 9 ounces; so that if two-hourly feeds are given from 7 a.m. till 9 p.m. about $3\frac{1}{2}$ pints can be taken. If smaller feeds are given, some nourishment can be taken later at night or earlier in the morning. In addition to the two-hourly feeds, most patients are allowed to drink as much water as desired, and if the nurse keeps the supply at the bedside cool and fresh it is likely that it will be taken freely. After a milky feed has been taken it is advisable to give a small drink of water in order to cleanse the mouth of milk.

A LIQUID DIET

This gives more opportunity of introducing variety than is possible

on a strict milk diet. For example, one or two beaten-up eggs may be given. An ordinary *egg flip* can be made by beating the white of an egg to a stiff froth, adding sugar or salt and pepper, and then pouring hot milk over it slowly, stirring all the time. *Eggnog* is both stimulating and nourishing. It is made by putting the beaten-up white of an egg into a tumbler and adding a teaspoonful each of cream and of brandy, with sugar to taste, and mixing well. Another type of stimulating egg drink is made by beating an egg-yolk with a teaspoonful of sugar and a tablespoonful of brandy until it is creamy, then adding the stiffly beaten white, and finally pouring over the mixture a teacup of milk, which may be either hot or cold as desired. After stirring well, this drink is served in a tumbler. Other suggestions and recipes for stimulating drinks will be found at the end of the book.

Broths and soups give variety to a fluid diet, but it must be remembered that only when containing milk, cream, yolk of egg, or vegetable purée have they much food value. Cereal milk gruel with sugar or salt, junket, and ice cream are welcome additions to a liquid diet. Fruit drinks are usually very acceptable and they form a medium by which extra sugar may be given. Glucose may be substituted for ordinary sugar when a greater Calorie intake is required and the patient does not like drinks to be very sweet.

LIGHT DIET

This is suitable for elderly patients, for patients who are awaiting operative treatment and as a transition from fluid diet to full diet. Its composition depends largely upon the type of illness from which the patient has been, or is, suffering. It includes up to two pints of milk a day, which can be used with eggs to make baked custard, omelets, milk puddings, ice-cream or thick soups. Grilled or steamed fish, chicken or rabbit, potatoes, green or root vegetables and stewed or raw fruit are also allowed; but the diet should not contain rich or highly seasoned foods. Potatoes are mashed if necessary and other vegetables can be sieved. If insufficient amounts of fruits and fresh vegetables are taken in the diet it is unlikely that the patient will obtain adequate amounts of vitamin C, so that rose hip or black-currant syrup or the juice of citrus fruits should, if possible, be added to the diet; but these should not be heated as vitamin C is unstable

to heat. When fruit juices are not available, tablets of ascorbic acid may be given.

FULL DIET

Unless the patient is obviously in a condition which contra-indicates the taking of an ordinary full diet, this is served to all patients until specific instructions as to diet are given by the physician. The usual hospital diet is comparatively liberal and it consists of fairly simple dishes which are easily prepared and digested. A patient confined to bed will be unable to digest and absorb as unrestricted a diet as he would if he were up and about. He has less appetite, mainly owing to the fact that his physical activity is curtailed, and it may be necessary to stimulate appetite by giving acid fruit juices, hors d'œuvre, moderately spiced foods, and soups; and above all by providing variety in the diet. Bitter tonics may be ordered as a means of stimulating gastric secretion and generating a feeling of hunger.

DIET IN CONVALESCENCE

During convalescence, the diet will naturally vary according to the condition from which the patient is recovering. For example, the diet of a boy with a broken leg will differ from that of a patient convalescing from acute appendicitis or from pneumonia; but in general it has two particular aims—to constitute a transition from the special diet needed during the acute stage of the illness to an ordinary full diet, and to restore the tissue losses sustained during the illness. The second objective demands a liberal proportion of easily digested proteins and a Calorie value higher than the body's usual requirements. Mineral salts, especially iron and calcium, should be abundantly present in the dietary, and so also should the vitamins, particularly vitamin D. An excess of alcohol and tobacco should be avoided, and the patient should have a period of rest before and after meals. Fresh air and moderate exercise between meals will stimulate appetite and aid digestion. Causes of worry and anxiety should be eliminated as far as possible, for these adversely affect the taking and utilizing of an adequate diet; and congenial and, if desired, lucrative, occupations should be provided in moderation so

that boredom is relieved. The success of the diet in convalescence is best estimated by weighing the patient weekly.

SPECIAL CONSIDERATIONS IN CONVALESCENCE

It has already been stated that diet in convalescence should be a high-protein, high-Calorie one, rich in vitamins and salts. But if the patient is obese the diet must be modified by restricting starches, sugars, and fats, and giving ample roughage, such as is obtained by fruit and vegetable salads and wholemeal bread. If atonic constipation is a feature of the convalescence, not only is ample roughage necessary but foods that are rich in vitamin B_1 and are slightly laxative should be included. Examples of such foods are Bemax, figs, apples, prunes, rhubarb, tomatoes, green vegetables, and, of course, wholemeal bread; for all these foods leave considerable residue in the intestines and stimulate peristalsis. The drinking of half a pint of hot water on waking in the morning is often beneficial to these patients. When, however, the convalescent patient is prone to diarrhœa or, for any reason, the stimulation of intestinal secretion and peristalsis is undesirable, the diet should be of a low-residue type. If the illness has left the patient in an anæmic condition, all those foods that are rich in iron should be given. These include egg-yolk, spinach, red meats, green vegetable salads, beans, lentils, carrots, prunes, grapes, raisins, dates, and whole-grain cereals. Liver is often given, although it is of less value in the secondary anæmia of convalescence than in the primary anæmia in which the hæmatinic factor is deficient or absent. This factor is normally produced in the stomach and is carried in the portal circulation to the liver, where it is stored. The anæmia of convalescence is usually due either to iron deficiency or to red-cell destruction by toxins.

Graduation in digestibility and size of the meals must be taken into consideration when planning the menu, and so also should the patient's usual dietary habits, unless these are found to be unsuitable to his needs and condition. The size and composition of the breakfast usually taken, whether his chief meal of the day is taken at midday or in the evening and whether sweet or savoury dishes are preferred, are some of the points that should be considered. For example, private patients are usually served with a light midday meal and a more substantial dinner in the early evening, whilst ward

patients have a midday dinner and a lighter meal in the evening, on the assumption that this arrangement is in line with the usual dietary habits of the majority of private and general ward patients respectively.

SERVING PATIENTS' MEALS

The digestion of a meal depends largely upon one's enjoyment of it, and any factor that disturbs one's peace of mind, creates bodily discomfort, or introduces an inharmonious element, can easily destroy appetite. As the time for serving meals approaches, anything that upsets the patients—such as painful dressings or disturbing topics of conversation—should be avoided. The ward should be as quiet and orderly as possible, screens should be placed around the bed of any patient who is seriously ill or obviously suffering, and the nursing staff should try to render the general atmosphere of the ward as pleasant and unhurried as possible. Usually, the ward sister will herself serve the meal, the junior student nurse or the ward maid or orderly having prepared the table in the ward kitchen with all the equipment needed and ascertained that the correct number of warmed and cold plates are available. If individual trays are used, these are daintily prepared with clean tray cloths, polished glass and silver, condiments, and anything else that may be required; taking care that nothing essential is forgotten and no forbidden article included —such as salt for a patient with a nephritic condition who is on a salt-free diet. The tray should be large enough to hold everything required without an appearance of crowding. If the patient is left-handed or for any reason is unable, temporarily, to use his right hand, he will appreciate the thoughtfulness of a nurse who reverses the usual order of equipment on his tray.

The nurses who are to assist in serving the meal should look neat and tidy. If long sleeves are worn these should be down and cuffs should be put on, aprons changed if necessary or clean overalls donned.

PREPARING THE PATIENT

Seeing that he must be as comfortable as possible if he is to do justice to his meal, he should be given an opportunity to use a bed-pan or urinal if these are required, and he should be made to feel

fresh and clean by having his face and hands sponged and his teeth cleansed. In busy wards it may not be possible to give these attentions to all patients under present conditions of staffing, but nurses should recognize it as the ideal and put it into practice whenever possible. The patient's position should be adjusted so that he can take his food with the maximum of comfort. His pillows should be arranged and, if he is sitting up, his shoulders and chest should be protected from cold, and the bed table and tray should be placed in a convenient position. The table upon which the tray is to stand must be cleared, except for flowers, and especially should disagreeable articles, such as a sputum container, be moved out of sight.

SERVING THE MEAL

There is some difference of opinion as to whether the patients should be asked what they would like to eat, for it is felt by some that this robs the meal of the element of surprise that is pleasant at all times, and especially so in illness. In some hospitals an electrically heated trolley, containing all the dishes provided for the meal, together with plates and servers, is wheeled round the ward and each patient is given a choice of the foods that are allowed for him. The individual tastes and antipathies of patients should be taken into account as far as possible. For instance, if a patient particularly dislikes vinegar, even in sauces and salad dressings, a dish may be rendered so distasteful to him that he may refuse the whole meal unless the nurse makes a point of remembering his dislike.

In actually serving the meal, care must be taken that cups, tumblers, and plates are not so full that splashing occurs in carrying them. Small amounts should be served and second helpings offered if desired. Hot food must be really hot and be served on hot plates; cold food must be kept chilled until it is served, and the remains of one course must be removed before the next is served. If a patient requires that his food be cut up, this should be done at once so that he is not kept helplessly waiting while the meal becomes cold. Sensitive patients will often leave food untasted if they cannot manage for themselves rather than ask for assistance, or, if they are kept waiting, any feeling of pleasurable anticipation they may have had gives way to an anxious irritability that impairs digestion. Trays and equipment should be removed immediately the meal is finished.

ASSISTING THE PATIENT

In feeding a helpless patient, any appearance of hurry should be avoided and the meal should not be taken to the bedside until the nurse is ready to give her attention to the patient. Feeding an adult patient successfully and agreeably is a real test of nursing ability. The tray should be where the patient can see it, for the sight of the food stimulates his appetite and gives him an opportunity to suggest the order in which he wishes to be fed. It is always embarrassing to need assistance in taking meals and it may make a patient feel that he is 'giving a lot of trouble'. This feeling may be minimized by ensuring that the clothing and bed linen are protected and tucking a napkin under the patient's chin. If the nurse seats herself comfortably on a conveniently high stool the patient often loses his sense of hurry. Friendly remarks contribute to a pleasant atmosphere and the feeling that the nurse is glad to give the help that is needed; but a conversation to which close attention must be given is undesirable. Unless a patient is very ill he will probably be able to help himself to bread, and he will prefer to wipe his mouth for himself. When a feeding cup is used a patient will soon learn to control the flow by placing his tongue over the spout, but it will not be necessary for him to do this often if the nurse is observant and thoughtful. After removing the tray, the patient's mouth is cleansed and a drink of water may be given. His position is then adjusted so that he can rest, or read if this is allowed.

CHAPTER 12

DIET IN FEVER

GENERAL CONSIDERATIONS

Any condition associated with a rise of temperature above the normal is considered to be a fever, but the elevation of temperature is never the only symptom. A quickened respiration and pulse rate are usually present, and in any case there is increased metabolic activity with greater combustion in the tissues and an accumulation of the waste products of metabolism, especially of nitrogenous, or protein, constituents. The pyrexia itself may be due to bacterial invasion and the distribution of their toxins by the circulatory system, or it may be the outcome of a metabolic disturbance such as results in hyperthyroidism. In the former, the high temperature is part of the body's defensive mechanism, for the vitality of many pathogenic organisms is weakened by high temperature. Physicians may, therefore, hesitate to prescribe measures for reducing temperature but, on the other hand, the persistence of a high temperature may lead to restlessness and delirium with consequent expenditure of muscular energy to no good purpose. In any case, a Calorie intake above the normal requirements is indicated, for unless the necessary fuel to maintain the temperature is provided in the food it must be taken from the reserves in the liver, the fatty tissues, or the muscles. The old dietetic practice of 'starving a fever' is now regarded as irrational.

There are, however, difficulties in feeding the patient because the toxæmia that is present in varying degree with all infections impairs the activity of most of the organs of the body. Digestion and assimilation are impaired mainly because there is a diminution of glandular secretion. Moreover, loss of appetite and nausea are common symptoms in pyrexia and the diet must be adjusted to meet all these conditions. The organs responsible for detoxicating and eliminating the waste products of protein metabolism—chiefly the liver and the

kidneys—have an additional burden placed upon them owing to the breakdown of muscle tissue. Every degree Centigrade (1·8°F.) causes an increase in metabolism amounting to about 10 per cent, and this increase involves a loss of body fluids. Beverages of all kinds must be given abundantly in order to prevent dehydration and to aid in the dilution and elimination of toxins and other waste products.

A satisfactory diet in fever should achieve the following ends:

1. It should tempt the dulled appetite of the patient.
2. It should be easily digested and assimilated and leave as little residue as possible to be excreted.
3. It should supply the energy needed for the increased metabolism.
4. It should repair and replace the damaged tissues.
5. It should maintain the biochemical reactions of the body—for example, it should counteract the acidosis that may result from a marked decrease of the normal glycogen store.
6. It should prevent dehydration and assist in the elimination of waste products.

DURATION OF FEVERS

Some fevers are of short duration, such as those that occur with colds, influenza, and pneumonia, and some forms of food poisoning. These are regarded as *acute fevers*, others run a longer course and are regarded as *subacute fevers*. These include typhoid fever, whooping cough, and some forms of bacterial endocarditis. Fevers that may last for months, or even years, are known as *chronic fevers*. The chief cause of chronic fever is tuberculosis. In each of these three types of fever there are special factors to be considered when arranging the nutrition of the patient.

DIET IN ACUTE FEVER

Since the fever is expected to be of short duration and because digestion and elimination are impaired, it is often desirable to disregard, for a few days, the needs arising from increased metabolism and the destruction of body proteins. But sufficient water must be given to prevent dehydration, and sufficient carbohydrate to prevent the acidosis that would occur from exhaustion of the glycogen reserves and to maintain muscle tone, especially cardiac muscle tone. If the

fever is prolonged the increased general demands must be met, and after it has subsided the necessity for replacement of tissue losses must be considered. There are, therefore, three stages in the dietetic treatment of acute fever—the onset diet, the continuation diet, and the recovery diet. The rapidity of the transition through these stages depends upon the type and duration of the illness and whether or not complications ensue.

THE ONSET DIET

A general liquid diet having a Calorie value of 1,200 to 1,800 will suffice during the initial stages of the fever. Its essential characteristics are that it must prevent dehydration and acidosis and be non-irritant to the alimentary tract. The chief substances given will be water, milk, sugar, cereals, eggs, fruit juice and 'Spanish cream' (which contains milk, egg, gelatine, and vanilla flavouring). Feeds should be small and be given frequently, but the maximum amount of water that the patient will tolerate should be taken. It is necessary for three reasons—to allay thirst, to prevent dehydration, and to assist urinary excretion. It need not be given as plain water, for lemonade, orangeade, barley water, broths, clear soups, tea, coffee, or cocoa provide palatable means of giving fluids. They may be taken hot, cold, or iced, according to the patient's preferences, and glucose or salt can be introduced into many of them. It is the usual practice to keep a small but attractive tray of refreshing drinks at the patient's bedside. The tray may contain a bottle of sweetened fruit juice, a jug of water covered with weighted muslin, some ice, and a tumbler. Fruit juices contain both carbohydrate and vitamins and their acid taste is pleasant. The citric acids are particularly useful because they leave an alkaline residue on digestion that helps in the prevention of acidosis. Aerated waters may be given unless the patient has a tendency to develop flatulence. In addition to the drinks that are given *ad libitum*, two-hourly nourishing feeds are given. Methods of giving milk and eggs that avoid monotony are discussed on pp. 119 and 278 and some recipes for both refreshing and nourishing drinks can be found at the end of the book.

THE CONTINUATION DIET

In acute respiratory diseases, such as pneumonia, it is important that the stomach should not be distended, as this would increase the respiratory difficulty. The onset diet *does* avoid unnecessary strain on the digestive organs, but it should not be continued for more than two or three days in any febrile condition. During the continuation period a relative rest to the digestive system must be maintained although the Calorie value of the diet is increased until it reaches 3,000 to 4,000 daily. Soft, easily digested solids, such as milk jelly, junket, lightly cooked eggs, omelets, custards, milk puddings, vegetable and fruit purées, fine cereals and cream, when this is available, are all valuable constituents of the continuation diet. Crisp toast is often welcomed by the patient as a change from soft foods, for it gives exercise to the muscles of mastication and helps in the cleansing of the mouth, and raw apple has a similar effect. Three-hourly feedings from 7 a.m. till 10 p.m., with intermediate fruit juice drinks, is the generally accepted régime, with modifications to meet special difficulties or needs.

RECOVERY, OR RESTORATION, DIET

As the fever subsides and the convalescent stage approaches the intervals between feedings are lengthened and the amount given is increased until three meals are taken daily, with intermediate refreshing or nourishing drinks. In this stage of the illness the patient's tastes and usual dietary habits should be consulted. Some people start the day with a good appetite and enjoy a substantial breakfast. Others prefer a light breakfast with a heavier midday meal but the appetite declines as the day advances; whereas a third group has little appetite in the earlier part of the day but can do justice to a high tea or an evening dinner. These are factors that should be considered when arranging the diet for an individual patient, although it is difficult when catering for a number. The main addition to the dietary during this stage is the introduction of flesh foods, such as fish, chicken and other poultry, sweetbreads, tripe, rabbit, lamb, mutton, and other meats; these being added gradually in order of digestibility. The satisfactory progress of the patient, from a nutritional point of view, is estimated by weekly weighing.

SPECIAL CONSIDERATIONS IN PARTICULAR FEVERS

TONSILLITIS

In this condition the throat is inflamed, swollen, and painful; and swallowing may be difficult. Iced drinks usually give some relief and are more easily taken than hot drinks or those at room temperature. Iced pineapple or grapefruit juice appears to be particularly welcome, and so does ice cream. In many hospitals ice cream is ordered as a routine food in tonsillitis and the post-operative feeding of tonsillectomy. Protein feeds may be helped by giving iced albumen water. As with all fevers, glucose and other sugars are added to the full extent of the patient's tolerance, with yeast tablets to supply the vitamin B_1 that is necessary for their metabolism. As the temperature declines and swallowing becomes easier, farinaceous foods, custards, jellies, and other soft solids are introduced, adding other foods gradually until the convalescent diet can be taken.

DIPHTHERIA

During the first week of the disease the usual *onset diet* may be given but, as the patient can often swallow semi-solids better than liquids, milk jelly, egg custard, Spanish cream, and Benger's food may be given. Glucose should be introduced into all feeds. After the first week the chief dietetic difficulty may arise because vomiting is apt to occur, and this will make partial or complete rest to the stomach a necessity. For a few days, rectal feeding or subcutaneous or intravenous injection of saline with glucose and crystalline vitamin B_1 may be the only forms of nourishment that can be given. From the second to the fourth week paralysis of the soft palate and upper alimentary tract may be a complication, and this will seriously interfere with feeding. Drinks may be regurgitated through the nose, although thickened fluids, junkets, and jellies, if given carefully with a spoon with the patient lying on his side, can often be swallowed with little difficulty. Placing the palms of the hands over the ears and exerting slight pressure in an upward and backward direction during the act of swallowing will often alleviate the pain that may be associated with deglutition and will lessen the tendency to regurgita-

tion. Alternatively, the feeds may be given through a nasal catheter, the most careful precautions being necessary in the passing of the tube, since the swallowing reflex is lost or impaired.

SCARLET FEVER

Apart from the painful condition of the throat, for which the same feeding as for tonsillitis may be given, the special dietary consideration in scarlet fever is related to the possibility of nephritis occurring as a complication. This may commence about the third week of the illness. A mild form, in which the only symptom is albuminuria, is treated dietetically by withholding salt. The question of protein restriction is regarded differently nowadays than in former times. The modern view is that the loss of serum albumen through the glomeruli of the kidney creates a need for its replacement by means of the diet rather than being an indication for the curtailment of proteins. If acute nephritis develops the dietary treatment follows that given for this disease.

In all conditions in which dietetic difficulties may arise after the patient has already had a period of illness lasting for several weeks, the importance of avoiding any form of inadequate nutrition in the early stages will be readily appreciated.

DIET IN SUBACUTE FEVER

The typical subacute fevers are whooping cough and typhoid fever. Both last for many weeks and are peculiarly debilitating; but the difficulties in maintaining adequate nutrition in the two conditions arise from very dissimilar causes. Other subacute fevers may be treated dietetically along the same lines, so that a discussion of the feeding of patients with these two diseases will deal with many points arising in the feeding of any case of prolonged, moderate fever.

WHOOPING COUGH

Although the pyrexia in this condition is of a mild type and is short in duration, the paroxysmal cough may last from four to six weeks. The patient frequently vomits at the end of a paroxysm and the paroxysms themselves are often most exhausting. The debility that follows from these two causes predisposes to both the complications and the sequelæ. Whooping cough may attack infants, but it

is most common about the age of four years and it is responsible for a large number of deaths of small children every year, the majority of which are due to the chief complication, which is broncho-pneumonia. Other complications are convulsions, epistaxis, collapse of the lung and emphysema, enlargement of bronchial glands and, occasionally, intestinal hernia. The most serious sequela is pulmonary tuberculosis. An alteration in the shape of the thorax leading to 'pigeon breast' may follow a prolonged attack.

A good nutritional standard in the feeding of these small patients is one of the most important aspects of treatment. An infant should be given a feed about ten minutes after a paroxysm ending in vomiting, irrespective of the time interval since the last feed was given. For older children the food should be light and nourishing, and it is essential that it should pass through the gastric phase of digestion as quickly as possible, on account of the tendency to expel the stomach contents. It may be advisable to peptonize milk, but this gives it a somewhat bitter taste. The addition of glucose and a pinch of sodium bicarbonate will help to make it more palatable. A small 'substitute meal' is sometimes given about twenty minutes before the regular meal is due, and if this is followed by a paroxysm that ends in vomiting the air passages are freed from mucus and a period of freedom from coughing will probably follow. The ordinary meal, which is then given at the usual time, is often retained. Concentrated foods of high Calorie value should be chosen. Milk, eggs, butter, fish, chicken and meat, and vegetable soups are preferable to starchy or sweet foods, and all dry foods that might irritate the larynx, such as biscuits, rusks, oatcakes, or nuts, should be avoided. It is a good plan to take advantage of a probable period of freedom whenever a paroxysm of coughing ending in vomiting has occurred, and to give the child a nourishing drink or a light meal immediately afterwards. Nausea and anorexia are, fortunately, rare in whooping cough. Cod or halibut liver oil should be given in order to ensure against a deficiency of vitamins A and D.

TYPHOID FEVER

Not only is this a long and wasting illness characterized by a greatly increased protein and carbohydrate metabolism, but the digestive powers are impaired by the toxæmia. There is ulceration of the lower part of the ileum, there is a risk of hæmorrhage or perforation during

the third week, there may be diarrhœa or constipation, and there is a tendency to meteorism (gaseous distension of the intestines). During the acute stage of the disease it is very difficult to get the patient to take nourishment. All these factors render the feeding of a patient with typhoid fever a major problem.

At one time it was the practice to give a very limited fluid diet for at least three weeks to a patient with typhoid fever. Since the second decade of this century, and mainly owing to the work of Dr. Warren Coleman, of New York, a new form of dietary treatment has developed which reduces the tissue losses and minimizes the length, the tedium, and the depression that were hitherto associated with the convalescent period of this disease.

The Coleman milk diet passes through three stages and consists of milk, cream, and lactose. It starts with 2 pints of milk and 1¾ ounces each of cream and lactose. This provides 1,000 Calories. The second-stage diet consists of 3 pints of milk, 8 ounces of cream and 4 ounces of lactose, and provides 2,000 Calories; whilst the third-stage diet consists of 3 pints of milk, 1 pint of cream, and 8 ounces of lactose, its total Calorie value being 3,000. These amounts are divided into eight equal parts, to be given at regular intervals during the day, the Calories being progressively increased until the full 3,000 are given.

The feeds become monotonous, so that as soon as possible, and usually by the end of the first week, a more varied high-Calorie liquid diet is given, passing on to soft solids by the addition of such foods as eggs, fine cereals, mashed potatoes, custard, and apple purée. Fruit juice is given freely and so also is water. The Calorie value of the diet may range from 3,000 to 6,000 daily by the third week. Then, vegetable purées, sieved fish, and minced chicken may be included, but only foods that will be digested and absorbed in the higher part of the intestinal canal and will leave little residue are given, and even in convalescence all foods leaving a coarse residue must be avoided. The foods that are contra-indicated for this reason are wholemeal bread, unpolished cereals, nuts, most green vegetables, fruits, and meat. No skins or seeds must be permitted. Vitamin preparations must be added when the diet appears to lack these important constituents. For example, the exclusion of whole-grain products involves a diminution of the vitamins in the B complex. This should be made good by giving yeast tablets or the pure crystal-

line forms of these vitamins. The need for vitamin C is greatly increased owing to the raised metabolism, so that ascorbic acid tablets must be given until the patient is able to take adequate amounts of fresh fruit juices.

By the fourth week, if no complications have occurred, an ordinary light diet may be given, passing on to full diet when convalescence is well established. Since the dietetic régime in typhoid fever has been so drastically changed the duration of the illness has been considerably shortened, the exhaustion has been lessened, and patients have been able to resume their ordinary avocations much earlier than formerly. The voracious appetite that was proverbial in the patient convalescent from typhoid fever when the diet had been restricted almost to starvation level for four to five weeks is not now in evidence.

A suggested menu for one day in the second week might be as follows:

		Approximate Calories
6 a.m.	Glass of milk (8 oz.) with cream and lactose	240
8 a.m.	Two ounces of cooked cereal—strained—with cream Coffee with cream and sugar One slice of crustless white bread and butter	450
10 a.m.	Eggnog	280
Noon.	Creamed vegetable soup Purée vegetable with butter Ice cream. Glass of milk, or milk tea	600
2 p.m.	Fruit juice with lactose	150
4 p.m.	Milk flavoured with cocoa, sugar to taste One slice crustless white bread and butter	260
6 p.m.	Apple purée with cream and sugar Cup of chocolate made with milk or coffee with cream	450
8 p.m.	Fruit flip, or orange eggnog	280
10 p.m.	A glass of malted milk or Ovaltine	220
If awake during the night—Fruit juice with lactose		150
	Total	3080 Calories

After the third week three meals of soft, high-Calorie foods can be given with one extra feed on waking, between the main meals, and at bedtime. There should be less pyrexia at this stage and the patient may have lightly boiled or scrambled eggs, custards, milk puddings, junket, milk jellies, cream cheese, mashed potato with butter or gravy, prepared breakfast foods, stewed apples and other soft cooked fruits without skin or pips, thin bread and butter, sponge cake, plain chocolate, and minced chicken or beef.

The forbidden foods include meat soups, gravies and broths, raw fruits or vegetables, seasoning and condiments other than salt, and, needless to say, hot or fresh bread, fried foods, and pastries.

A suggested menu for one day in the fourth week of typhoid fever is as follows:

	Approximate Calories
On waking—A glass of milk (8 oz.)	160
Breakfast—Fruit juice (8 oz.) or baked apple with sugar Strained, cooked cereal, with cream Poached egg, white bread and butter Coffee with cream and sugar	920
Mid-morning—A glass of milk A slice of buttered toast A little plain chocolate	290
Midday—Scrambled egg Mashed potato with butter Purée of asparagus, cooked celery, green peas or spinach—strained A slice of toast, butter Ice cream or milk jelly with cream Cocoa or coffee with milk	800
4 p.m.—Thin bread and butter A little sponge cake with honey or seedless jam Milk tea, or plain tea with cream	280
Supper—Cream vegetable soup Minced chicken Mashed potato with butter Milk pudding or cream cheese Bread and butter	900
At bedtime—Malted milk, Ovaltine, plain milk with cream or orange eggnog	240
Total	3,590 Calories

CHAPTER 13

DIET IN TUBERCULOSIS

Pulmonary tuberculosis is a disease that runs an unusually long course. The patient may be confined to bed, he may be allowed up for part of the day, or he may be fully ambulatory; for most patients experience alternating periods during which the symptoms may be active or may show a marked remission. In the acute stage the temperature may be high, but this stage is not of long duration in favourable cases. There is usually, however, a tendency to slight rises of temperature extending over a long period of time. Other symptoms are cough and expectoration and a loss of weight and strength. The appetite will probably be capricious and there is a liability to gastro-intestinal upsets, probably due to the absorption of toxic products from the diseased tissues.

The dietary treatment of tuberculosis is a subject upon which somewhat differing opinions are held by various authorities, influenced probably by the fact that in this malady more than in most others one is treating an individual rather than a disease; for when a person realizes that he has developed tuberculosis he is faced with the problem of readjusting his whole life to a changed outlook, and many factors in his physical, mental, and emotional make-up need to be taken into account. This is especially true in pulmonary tuberculosis. Many of the people who contract this disease are poor and undernourished and the defects in nutrition must be remedied, so that in the early stages of treatment more food may be necessary for tuberculous than for ordinary people; but the excessive feeding that used to be so popular is undesirable, for it often causes dyspepsia.

In arranging the diet consideration must be given to the patient's special requirements. The adjustment of its various constituents depends upon the stage of the patient's illness and the particular symptoms he is manifesting. While he is in bed he is given a fairly full and nutritious diet, and this is augmented as he gets up for short periods until, when he is fully ambulatory, he should be taking

a diet rather more generous than is required for a person in full health.

SPECIAL MODIFICATIONS

In Calorie Value. Unless the temperature is high there is only a very moderate increase in metabolic rate, but there is progressive loss of weight. The Calorie value of the diet should, therefore, be a little above the normal requirements. The patient should be weighed weekly and his weight taken as a guide. It is not considered advisable that it should be above the average weight for height because excessive fat decreases general ability to resist disease.

In protein. At one time a high protein diet was advocated in pulmonary tuberculosis in order to repair the wasted tissues; but proteins are said to stimulate basal metabolism and to increase respiratory activity. The general trend at the present time is against a marked increase in the intake of proteins above the normal requirements in health. Not more than 1·5 grammes per kilogramme of body weight is advised. One good helping of fish and of meat, one egg, and one pint of milk daily will ensure an adequate intake for an average-sized person.

In fats. The easily emulsified fats, such as cream, butter, and the phosphorized fat of egg-yolk, are very suitable for inclusion in the diet for tuberculosis. They provide the extra Calories required as well as the fat-soluble vitamins and, by reason of their composition, they produce less carbon dioxide than do carbohydrates to be eliminated by the lungs and, consequently, they do not increase the volume of breathing to the same extent. But an increased fat intake may cause nausea. If that occurs the necessary Calories must be supplied by sugars and starches.

In carbohydrates. There has been much discussion of late as to the relative proportions of carbohydrates and fats that should be included in the diet of tuberculous patients. Recently, a high-Calorie diet has been advocated in which the carbohydrate intake is increased to bring the total Calories up to 4,000 daily, with small doses of insulin twenty to thirty minutes before each meal. This treatment is, however, of rather doubtful value and is not widely used. The insulin causes the patient to feel very hungry, so that he takes his food with relish and enjoyment. It overcomes the anorexia and capricious

appetite that so often presents a difficulty in ensuring adequate nutrition for patients with tuberculosis. A régime that is being followed at the present time involves the injection of 10 units before each of the three main meals and three other injections about two hours after the meals, followed in thirty minutes by 6 ounces of sweetened fruit juice. The patient is given an extra allowance of bread, butter, and jam; cereals made with milk are included in the dietary and soups are thickened with flour. Following this dietary in some cases a decrease in the activity of the lesions has been evidenced by a decline in the erythrocyte sedimentation rate; but in many cases the disadvantages of insulin administration when the tuberculosis is uncomplicated by diabetes mellitis appear to outweigh the advantages. Six injections a day are unpleasant for the patient, and so also are the symptoms of mild hypoglycæmia that are produced, and when once the treatment is discontinued the gain in weight is seldom maintained.

In vitamins. It has been realized at least for the past century that cod liver oil is good for patients with tuberculosis, but its use is still empirical although we now know that its therapeutic value is due mainly to the fact that it is a rich source of vitamins A and D. It is known by experience that an excess of these vitamins is advisable in tuberculosis. Their intake may be increased by giving Adexolin, Radiostoleum, and Haliverol instead of cod or halibut liver oil if the patient prefers these preparations. Absorption of vitamin A is less efficient in people with tuberculosis than in healthy people, and it is reputed that there is a high incidence of impaired dark adaptation among the tuberculous, which suggests that vitamin A therapy is important for these patients.

Recent research has indicated that a much larger quantity of vitamin C is required by a tuberculous patient than by a person in good health, especially when there is any degree of pyrexia. The diet should provide liberal amounts and these can be augmented by giving ascorbic acid tablets if fresh fruits and raw vegetables are not freely available. The recommended dosage is 150 milligrammes of ascorbic acid daily unless the patient has a long-continued hectic pyrexia, when as much as 300 to 500 milligrammes can be given daily with advantage. Marmite and Bemax are very useful sources of vitamin B_1 and the former is often much appreciated in sandwiches or in soups.

In mineral salts. The two minerals that appear to be required in excess are calcium and phosphorus; but, although calcification of the lesions is a necessary process for recovery, there is no conclusive evidence to show that calcification is accelerated by administration of *excess* calcium and vitamin D. Milk, cream, eggs, and cheese will provide the required amounts of both calcium and phosphorus.

Water and stimulants. Many patients with pulmonary tuberculosis find that if copious fluids are taken with meals the tendency to nausea and dyspepsia is increased. One to two ounces of tomato or fruit juice is usually sufficient for inclusion in each of the main meals of the day, but drinks should be taken more copiously between meals. Light wines, beer, or stout in strict moderation may be allowed, but the tuberculous patient should not take stimulants as a pick-me-up when he feels tired; he must always regard tiredness as an indication that he needs rest.

Roughage. As a general rule, roughage should be cut down to a minimum if the patient has a tendency to gastro-intestinal attacks; otherwise it may be present in normal amounts, no efforts being made to increase its intake.

SMOKING

If this is allowed, and it usually is when laryngitis or bronchitis is not a feature of the condition, it should be impressed upon the patient that he should not smoke before a meal, for smoking dulls the appetite, and, in view of the common incidence of anorexia and the tendency to loss of weight, any factor that might limit the intake of food is undesirable. Smoking after meals is usually permissible unless the cough is a marked or troublesome symptom.

IMPORTANCE OF REST BEFORE MEALS

The patient should not be allowed to become tired shortly before a meal, for he cannot then obtain the best results from his diet. This applies particularly to patients who are allowed up, and it is the rule in most sanatoria that half to one hour's rest on a couch or bed is taken before each meal. Fatigue predisposes to nausea and to subsequent gastro-intestinal attacks; and recovery is thus retarded. Overfeeding, over-rich food, or a high proportion of roughage should be avoided for the same reason.

PRESENTING THE DIET

It has been truly said that a good cook is more useful than a detailed diet sheet to a patient with tuberculosis. The manner in which food is prepared and presented is always of great importance, especially when the patient is on 'bed-rest'. He often feels quite well and the time passes very slowly. Meal-times become important events in the day, to which he looks forward with pleasure. His anticipation is increased if he does not know what is to be served on a particular day or at a stated meal. An attractive tray is specially important to these patients. Hot dishes should be really hot, and this is often rather difficult during the winter months in open sanatorium wards. The provision of electrically heated food trolleys or of insulated trolleys and of hot-water plates is a considerable help under such circumstances. It is better to serve a very moderate quantity at a first helping and to give a second helping if desired rather than to overload a plate. All meals should be simply prepared but should appeal to both the eye and the palate. Three good meals a day are usually sufficient, with a small tea between the midday and the evening meal and a glass of milk when retiring. Feeds given between the principal meals often impair appetite and may give rise to dyspepsia.

SPECIAL MODIFICATIONS

In tuberculous enteritis. When this condition has been diagnosed two points need special consideration—the limitation of roughage and the patient's intolerance of milk and other fluids. To meet the first need, all vegetables and fruits should be sieved, no pips or skins being allowed, and porridge should be omitted from the diet. Milk and soft carbohydrate foods are apt to cause painful and offensive diarrhœa, often with considerable flatulence. Milk is, however, one of the main sources of calcium. To compensate for its exclusion, calcium lactate may be given. Dried milk is of considerable value in enteritis, for it is less liable to undergo putrefaction than fresh milk. Vitamin B_1 is particularly necessary in enteritis, and most of the foods containing it are contra-indicated because of their roughage content; so that the crystalline aneurin should be given either orally or intravenously, or yeast tablets may be ordered. In general, a dry, low-residue diet with a high vitamin content is prescribed, the patient

being fed at frequent intervals with small meals of steamed fish, clear soup, custard, jellies, crisp toast, and eggs in various forms. The soft diet recommended for the later stages of typhoid fever is found to be very suitable, the stools ceasing to be offensive and the diarrhœa and flatulence often considerably relieved.

In tuberculous meningitis. Easily digested solid or semi-solid food should be given regularly as long as it is possible for the patient to take it. As coma supervenes it becomes necessary to give nasal feeds.

In tuberculous laryngitis. Swallowing may be painful and difficult and it is sometimes impossible for the patient to take solid food. Very soft solids and thickened liquids are the easiest forms in which nutriment can be given by mouth, and if the patient lies on his side or in the prone position the difficulty with swallowing may be lessened. A straw is often of great help in taking liquids, but each patient's experience should be considered. Before giving food the dysphagia may be treated by spraying the throat with a mild analgesic containing aspirin, chloretone, cocaine, or heroin in solution. In advanced cases 5 per cent cocaine is needed. The patient may be taught to use the spray himself. Alternatively, a little orthoform powder may be placed on a watch glass or a small saucer, the patient being instructed to inhale it through a Leduc's tube—which is made of glass.

After hæmoptysis. At one time it was thought advisable to refrain from giving feeds for some hours after a hæmoptysis, and then to keep the patient on fluids only for several days. Later, it became the practice to give milk and ice cream for twenty-four hours, commencing as soon as the bleeding has stopped, and then to introduce other articles gradually until the full diet is resumed a few days later; whilst the modern view is that an hæmoptysis does not necessitate any modification in diet.

In tuberculosis of the skin. A diet rich in vegetables and vitamins but without chlorides was first suggested for cutaneous tuberculosis by M. Gerson. It was subsequently modified by Sauerbruch, Hermansdorfer, and others, and in its modified form it is often used in the treatment of *lupus vulgaris*. Not all cases respond successfully but some remarkable improvements have been reported in which there was resorption of the infiltrations and accelerated growth of normal skin.

The foods to be excluded are common salt, smoked or salted meat

and fish, soup extracts, seasonings, pickles, and salted butter. Foods that are allowed to a limited degree include salt-free bread, potatoes, cereals, pepper, vinegar, beer, wines, coffee, cocoa, and tea.

Recommended foods include fresh meat, fresh fish, milk, eggs, cheese if poor in salt, salt-free butter and butter substitutes, jams, marmalade, fruit bread, fruit juices and jellies, as much raw fruit as possible, dried fruits such as raisins, dates, sultanas, and figs, nuts, and an abundance of vegetables of all kinds. The vegetables that need cooking should be steamed, not boiled, and no salt must be added. Herbs, such as parsley, mint, sage, capers, and borage, are allowed.

The use of a special salt which does not contain chlorides is sometimes permissible for those patients who find salt-free foods unpalatable. Some 'dietetic' salts contain compounds of sodium potassium, calcium, and magnesium, and they taste very much the same as sodium chloride.

CHAPTER 14

DIET IN GASTRIC AND DUODENAL CONDITIONS

The dietetic treatment of gastric disorders must depend, primarily, upon whether the disorder is organic, functional, or reflex in origin. Organic diseases are the result of pathological changes in structure. In the stomach, these include gastric ulcer, fibrous contractions, and carcinoma. Functional conditions result from disturbances of the nerve controls of digestion, and these may be motor, sensory, or secretory in nature. Reflex dyspepsia or vomiting may be due to pathological disturbances in other organs, such as the appendix, the gall bladder, the kidney, or the uterus; and pulmonary tuberculosis often has a marked effect upon gastric function.

The physician will first determine whether the disordered function has its origin in the stomach itself or not. If he concludes that it is of gastric origin investigation will be carried out in order to demonstrate the presence of a lesion, or show whether a functional disorder is due to defects in muscular contraction or in secretory function.

FUNCTIONAL CONDITIONS

It is well known that fatigue, worry, mental strain, and emotional stress play a part in decreasing appetite and in impairing digestion. They can also cause nausea and vomiting. This is because the nerve supply to the stomach is mainly from the autonomic system, which is specially stimulated by emotion and other psychic factors. Stimulation of the sympathetic section of the autonomic system causes relaxation of the muscular walls of the stomach and contraction of the pylorus, whereas stimulation of the parasympathetic section acts through the vagus nerve in contracting the stomach walls and relaxing the pylorus. When this neuromuscular balance is upset the stomach may contract whilst the pylorus is in spasm, giving rise to gastric pain and expulsion of the stomach contents through the œsophagus

in the act of vomiting; or the stomach wall may remain flaccid—a condition known as gastric atony—the food remaining in the stomach for an undesirable period and fermentative changes taking place which lead to gaseous distension. Most gastric pain is now thought to be due to alterations in the tension of the muscular walls rather than to alterations in the acidity of the gastric secretions. Nevertheless, defective secretion interacts with defective muscular action to bring about both functional and organic diseases. Among the functional conditions which commonly arise are dyspepsia, hyper-acidity, hypo-acidity, and gastric atony., Frequently, more than one of these are present at the same time.

FUNCTIONAL DYSPEPSIA, OR NERVOUS INDIGESTION

Functional dyspepsia is usually chronic, and before prescribing any definite diet the cause of the condition should be investigated. Among the sufferers are persons with unstable nervous tempera-ments who are subjected to domestic or business worries, or who find the strain and speed of life in a mechanized age too wearing. Often there is an underlying psychoneurosis or 'anxiety state'. Naturally, war conditions accentuated all the foregoing factors and these factors can operate to bring about a functional dyspepsia at any age; for the condition is often found in children who lack a stabilized home life or who are pampered 'only' children. In all these cases it is futile to treat the gastric condition by diet whilst the underlying maladjustment is neglected.

Apart from psychological factors, functional dyspepsia may be due to wrong selection of food, unsatisfactory cooking, rapid eating with insufficient mastication, an idiosyncrasy for certain foods, or over-indulgence in tobacco or alcohol. In addition, the habitual taking of too much or too little food may lead to gastric discomfort.

In the selection of food the chief errors are the taking of excessive fats, concentrated sweets, tough fibre of meat and vegetables, acids and spices or volatile oils. Fats inhibit gastric secretion and therefore digestion is delayed. Fried foods, heavy salad dressings, rich pastries, nuts, and fatty fish are the chief foods that provide excessive fat. Sweets taken between meals or on an empty stomach may conduce to dyspepsia. Tough-fibred foods remain in the stomach too long. On the other hand, the extractives of meat and various sauces are

stimulants of gastric secretion and therefore tend to shorten the emptying time of the stomach. Certain vegetables and fruits contain coarse cellulose and some, such as onions, contain volatile oils that may disagree with digestion; whilst acids and spices, such as are contained in pickles, vinegar, curries, and some of the more acid fruits, may cause discomfort or pain by irritating the gastric mucosa and increasing the acidity of the stomach contents.

Cooking defects include undercooking of starchy foods and of meat such as veal and pork, overcooking of vegetables, and the frying of food in fat of too low a temperature, with the result that the fat penetrates the food. Taking meals too quickly without sufficient mastication may be due to dental inadequacies. These should be excluded before attempting to treat the dyspepsia; and so should the taking of excess fluids with meals. An idiosyncrasy to certain foods may be a true allergic sensitivity in which not only dyspepsia but also skin eruptions may occur; but it is often psychic in origin, the patient's idea that a certain food always disagrees with him becoming so fixed that it amounts almost to a conditioned reflex.

The diet in dyspepsia must be one that relieves the symptoms and promotes the cure. Generally speaking, a 'light gastric diet', such as is given in cases of healed ulcer, is suitable; but any food known to disagree with the patient must be avoided and he must be instructed to eat slowly and to masticate thoroughly. Smoking or the taking of alcohol before meals must be avoided and indulgence at other times should be in strict moderation. It is usually desirable that the diet should be written out for the patient, for each case of dyspepsia is an individual one and demands some special adjustment to fit with the patient's circumstances and his type of employment. A specimen diet is as follows:

On waking—A glass of tomato or orange juice.

Breakfast—Well-cooked cereal with milk or cream. Lightly boiled or poached egg, toast, butter, marmalade, or fruit jelly. One cup of tea or coffee.

Mid-morning—A beverage such as milk, cocoa, Ovaltine, or coffee.

Lunch—Chicken or omelet, mashed potato and purée of another vegetable, or lettuce salad without mayonnaise, stewed fruit with junket, jelly, custard, or cornflour shape.

Tea—One cup of freshly made tea, bread or toast with butter and fruit jelly, plain cake.

Dinner—Thick, strained soup, steamed or grilled fish, vegetables, and sweets as for lunch, biscuits, cheese, butter, coffee with milk.

On retiring—Milk, cocoa, or Ovaltine.

HYPERACIDITY, OR HYPERCHLORHYDRIA

This condition has, for many years, been regarded as an important predisposing cause of peptic ulcer. It frequently occurs in highly strung, nervous individuals and may lead to attacks of so-called acute gastritis associated with marked discomfort and pain. The acid acts as an irritant to the gastric mucosa, giving rise to inflammation, but, as the mucosa is not provided with sensory nerves capable of being affected by degrees of acidity, the symptoms are thought to be due to alterations in tension of the muscular walls of the stomach. Normally, the acid readily unites with the protein of food, thus enabling the pepsin action to take place. The acid is then said to be 'fixed', and any excess is known as 'free acid'. An undue amount of free acid may cause spasm of the pylorus and lengthen the emptying time of the stomach. This in time permits a longer secretory period for gastric juice and lessens the regurgitation of alkaline juices from the duodenum. Thus, the hyperchlorhydria tends to become progressively increased; but whatever the cause or the processes through which the hyperchlorhydria develops, it is known that the character of the food intake can alleviate or even remedy the condition.

Dietetic treatment is directed towards two ends—the limiting of acid secretion and the fixing of the acid. The essential modifications that are necessary are as follows:

In fat content. Fats are known to inhibit the secretion of hydrochloric acid, so these are given as freely as is desirable, especially in their emulsified form as cream and butter; but olive oil is also useful. Fried foods, however, are irritating to the stomach and are often indigestible. Too much fat prolongs the emptying period of the stomach; for this reason, and because they tend to be nauseating, they must not be given immoderately.

In protein content. The proteins that combine most readily with hydrochloric acid, such as those of milk, eggs, and cheese, and, to a lesser extent, of white fish and poultry, should be given freely.

In carbohydrate content. Sugars may give rise to acid fermentation and so should be limited. Starches in the form of well-cooked cereals,

spaghetti, marcaroni, vermicelli, bread, and potatoes are suitable foods.

In stimulating foods. Meat extracts, highly seasoned foods, condiments, acid fruits, pickles, vinegar, strong tea and coffee, and alcohol must be avoided, for they stimulate gastric secretion. If smoking is allowed it must be confined to the period after meals.

In residue. Foods containing cellulose, tough-fibred meats, wholemeal, or branny cereals should not be given. They increase the bulk of food in the stomach, and pressure increases the secretion of the already overactive cells.

In fluids. Meals should be given dry, except for tomato juice or fruit juices, and water should be taken between meals.

HYPO-ACIDITY, OR HYPOCHLORHYDRIA

This term denotes that the amount of hydrochloric acid secreted is below normal. *Achlorhydria* denotes that no free acid is found but some combined, or fixed, acid is present. *Achylia gastrica* means that not only is hydrochloric acid completely lacking but the secretion of gastric enzymes is deficient. These two conditions are characteristic symptoms in pernicious anæmia, and they also occur in carcinoma of the stomach. A modern theory with regard to pernicious anæmia is that it is itself a *result* of the complete absence of gastric acid secretion and of pepsin and rennin, for under such conditions the hæmopoietic, or anti-anæmic, factor cannot be secreted.

In the dietary treatment of hypochlorhydria the important modifications include the limitation of fats, fried foods, twice-cooked meats, rich pastries, and heavy puddings. On the other hand, fresh-cooked meat, liver, soups, well-cooked cereals excepting oatmeal, condiments, spices, and fruit juices are recommended. If no organic lesions are present, the judicious use of alcohol may be helpful, a small glass of wine, beer, or even spirits before a meal being of value in stimulating secretion. Roughage is avoided, but for a different reason from that operating in hyperacidity; for if the food remains in the stomach longer than is normal, fermentation may occur, especially of carbohydrate such as cane sugar and potatoes. Vegetables must be well cooked and broken up or sieved to remove fibres. The meals must be small, the foods minced or finely divided, and the patient must pay attention to the thorough mastication of all solids. A medicine

containing hydrochloric acid may be ordered, to be given before meals.

GASTRIC ATONY

This condition is often associated with deficient gastric secretion. It is usually chronic. It may be obstructive, due to contraction or pressure near the pyloric outlet; or non-obstructive, due to loss of tone of the muscular coat. The latter may result from defective innervation or repeated over-distension by excessive meals, or it may be associated with constitutional diseases such as the anæmias and some of the fevers. It frequently occurs in *chronic gastric catarrh*, and in this condition there is an excessive secretion of mucus into the stomach. Vomiting of this mucus frequently occurs on waking and there is anorexia in the mornings, probably due to accumulation of mucus, but the appetite improves as the day advances. The treatment includes daily gastric lavage before breakfast, with a solution of sodium bicarbonate, continued until the fluid is returned clear of mucus. In severe cases it may be necessary to repeat the lavage later in the day. The patient can learn to carry out this treatment for himself. As improvement occurs the lavage is gradually discontinued, the patient taking a teaspoonful of sodium bicarbonate in a tumbler of warm water on awaking in the morning, repeating it before meals if the mucus accumulates sufficiently to make this necessary. *Carlsbad water*, or its substitute consisting of a teaspoonful of sodium phosphate in a tumbler of water, is often beneficial in cases of chronic gastric catarrh.

The dietary modification for gastric atony are on the same lines as for hypochlorhydria. Attractive meals are served in small quantities, finely minced and dry, and adequate in Calories, minerals, and vitamins. In order to stimulate the secretion of gastric juice, soups and meat extracts may be given at the commencement of the main meals, and, since achlorhydria is often associated with deficiency of the vitamins of the B complex, Marmite as a beverage or in sandwiches is to be recommended. Lactose is given instead of cane sugar. Apart from the soups or meat extracts, fluids should not be given until an hour or two after a meal and then in restricted quantities. In severe cases, peptonized milk only may be given for a few days. It is sometimes necessary to supplement the fluid intake by giving saline or tap water per rectum.

GASTRIC AND DUODENAL ULCER

The term *peptic ulcer* is now taken to include ulcers of the stomach and of the duodenum. In the stomach the lesion is usually along the lesser curvature near the pylorus. When occurring in the duodenum the most common site is within a few inches of the pylorus. In both situations the ulcer is associated with considerable pain, which may be relieved in the case of a gastric ulcer by the taking of an alkali, or in the case of a duodenal ulcer by the taking of food. All peptic ulcers are liable to endanger life by eroding a blood-vessel or by perforating the gastric or duodenal wall. Hyperchlorhydria is frequently present. The stools may contain occult blood. Recurrent attacks lasting for a few weeks may occur intermittently for some years, these attacks being precipitated by any emotional strain, by excessive use of alcohol, or by indiscretions in diet. In cases of long duration there is often loss of weight and dehydration.

Many theories have been advanced as to the causation of these ulcers. Neurogenic factors are considered to be important, for it is thought that worry, mental tension, frustration, or fear may result in circulatory deficiency to the mucosa, the impoverishment of the blood supply leading to erosion. The abnormally high concentration of acid probably intensifies the necrotic process and interferes with healing. Some authorities believe that emotional conflict is accompanied by accelerated acid secretion, engorgement of the gastric mucosa, and hypermotility. There may also be focal infection; for example, from the swallowing of septic material from carious teeth.

It is obvious, therefore, that although diet is of importance in the treatment of peptic ulcer, it must be preceded by the elimination of any septic focus that can be found, and it must be accompanied by physical rest and freedom from anxiety and mental conflict. This involves rest in bed for a period of from a few weeks to several months, preferably in a hospital or nursing home, and a consideration of each patient as an individual with his own special problems and difficulties. Only thus can dietary treatment hope to be successful.

Probably in no other condition are diets so rigidly standardized as in peptic ulcer although in every case the choice of the dietary must be based upon the ability of the food to neutralize acid, to over-

come spasm of the pylorus, and to maintain general nutrition. There are four widely used special diets forming the basis of dietary treatment of peptic ulcer, each of them being known by the name of its originator—Lenhartz, Sippy, Hurst, and Meulengracht—the last two being the more in favour at the present time, modifications being made to suit the need of the individual and to meet his particular problems. The earlier diets, such as those designed by Lenhartz and Sippy, often lacked sufficient vitamins and minerals and the patient found them very monotonous. However, they formed the basis upon which the more modern gastric diets were constructed, so that it would be well to give them some consideration.

LENHARTZ DIET

The aims of this régime are: (1) the giving of small frequent feeds that will leave the stomach readily without causing irritation or distension, (2) the inclusion of a high proportion of protein so that the hydrochloric acid, which is usually in excess, shall be utilized, (3) the provision of sufficient nourishment to improve the general condition and to promote healing of the ulcer, and (4) the avoidance of any food that is likely to stimulate gastric secretion, such as condiments, spices, meat extracts, strong tea or coffee, and vinegar.

On the first day, 8 ounces of milk with one beaten-up egg is divided into 15 hourly feeds to be given from 7 a.m. till 9 p.m.; but this is increased each day by adding 4 ounces of milk and one egg until by the beginning of the second week $1\frac{3}{4}$ pints of milk and 8 eggs are taken in the day's feeds. From the third day sugar is added. For the first few days both the food and the feeding utensils are kept in the refrigerator and the feeds are served cold. Towards the end of the week some form of light cooking is allowed, for instance, an egg custard may be made. If there is still pain or vomiting no further additions are made to the dietary, but if these symptoms have subsided 1 ounce of raw or cooked minced meat may be added daily from the beginning of the second week, and the diet is gradually extended to include well-cooked rice and other cereals, strained porridge, bread, toast, and butter, giving less eggs. Minced fish or chicken, or well-cooked tripe, are given to replace and increase the protein as the number of eggs is reduced. Vegetables are allowed only in the later stages and they must be mashed or sieved. Fruit juice

may be given to supplement vitamin C, and the fat content may be augmented by giving olive oil.

SIPPY DIET

This is a more severe line of treatment which is seldom followed nowadays in its entirety, although its influence is seen in most of the gastric diets in present use. In its original form the food constituents were, at first, only milk and cream, the dietary treatment being combined with gastric lavage and the administration of alkalis, belladonna, and olive oil. The details of the treatment are as follows:

(1) Rest in bed for three or four weeks, the patient being allowed up only for a daily bath and visits to the lavatory.

(2) Three ounces of equal parts of milk and cream with the addition of sodium citrate, grains 10, given hourly from 7 a.m. till 7 p.m. After three to four days this is augmented by a lightly cooked egg with one of the morning feeds, and 3 ounces of well-cooked cereal with one of the afternoon feeds. Gradually other feeds are augmented in the same way until by the tenth day the patient is receiving three soft-cooked eggs and 9 ounces of cereal, the egg and the cereal meals alternating, and being interspersed with feeds of milk and cream.

(3) Before alternate feeds 2 to 4 drachms of olive oil are given, and before the remaining feeds five minims of tincture of belladonna. The oil is nutritive and non-irritating and, like the belladonna, it inhibits gastric secretion.

(4) Half an hour after each feed, and continuing hourly until 9.30 p.m., alkaline powders are given.

(5) At 10 p.m. the stomach is washed out and atropine sulphate grain $\frac{1}{150}$ is given hypodermically. At 6 a.m. half an ounce of bismuth carbonate, shaken up with 5 ounces of water, is given to coat and protect the ulcer preparatory to giving the first feed of the next day.

The administration of this diet and general régime was continued until gastric pain and tenderness and occult blood in the stools had been absent for three weeks. The results were good as regards the healing of the ulcer but the treatment imposed a great strain upon both patient and nurse, seeing that some attention had to be given every half-hour, the diet was uninteresting, it was deficient in iron and in vitamin C, and it was somewhat constipating.

HURST'S DIET

This régime was developed by Sir Arthur Hurst from the Sippy treatment. It too requires half-hourly attention to the patient, but the composition of the diet approaches more nearly to that of a normal individual, even in the first stages of treatment, and drugs are used in addition to the diet. The object is to procure continuous neutralization of hydrochloric acid and, although that cannot be entirely achieved, the treatment has been used extensively in Britain and it has withstood the test of time in that, when it can be carried out in its entirety, it is effective in the healing of the ulcer. As given by Hurst himself, the régime is arranged in three stages.

STAGE 1.—STRICT ULCER TREATMENT

During this stage the patient should remain in bed. In no case should this stage of treatment be for less than four weeks. It must be continued until the radiograph shows that the ulcer cavity is filled, and occult blood has disappeared from the stools.

Feeding. Five ounces of milk every other hour from 8 a.m. till 10 p.m. This may be warm or cold and be flavoured with tea if desired, 10 grains of sodium citrate being added to each milk feed.

Five-ounce feeds every other hour from 9 a.m. till 9 p.m. These may be made of arrowroot, Farola, Benger's food, junket or custard. Red currant, apple or other fruit jelly may be added and the junket may be flavoured with chocolate.

A rusk with butter should be taken with three feeds. A 'coddled egg' and some thin bread and butter may be taken once or twice a day if the patient has adequate dentures and can be relied upon to masticate thoroughly.

One ounce of cream should be added to the 11 a.m., 1 p.m., and 5 p.m. feeds, and half an ounce of olive oil should be taken before the 9 a.m., 2 p.m., and 7 p.m. feeds.

Small quantities of water may be taken between feeds, an ounce of strained orange juice being added to three or four of the drinks.

Citrated milk should be placed at the patient's bedside at night so that if he wakes he can take a feed.

Drugs. Atropine sulphate $\frac{1}{150}$ grain in a teaspoon of water before the 8 a.m. and 3 p.m. feeds, and twice this dose before the 10 p.m. feed. The atropine mixture should be increased by 10 minims in each dose

every day until an unpleasant feeling of dryness of the mouth occurs. The dose should then be reduced to that of the previous day.

Half a teaspoonful of magnesium trisilicate halfway between feeds and a teaspoonful last thing at night.

General. The mouth must be washed out and the teeth cleaned after each feed. No smoking is allowed during this stage of treatment. If constipation is present it is treated by giving a tablespoonful of liquid paraffin morning and evening.

The patient should be weighed once a week. If he were underweight and has not gained, the feeds should be increased to 6 or 7 ounces. An overweight patient who has not lost weight should have his feeds reduced to 4 or even 3 ounces.

STAGE 2.—CONTINUATION TREATMENT

This provides a suitable transition between the strict ulcer treatment and the post-ulcer régime. It should be continued for two to three weeks. All articles of food allowed in the first stage may be taken. The arrangement of Stage 2 is as follows:

At 9 *a.m. and* 4 *p.m.*—Weak, milky tea, one or two lightly boiled, poached, or scrambled eggs, thin bread and butter or toast. A teaspoonful of the atropine mixture and a tablespoonful of olive oil should be given a quarter of an hour before each of these two meals.

At 1 *p.m. and* 7 *p.m.* Fish or chicken with mashed potatoes and other vegetable purées. Custard or junket, etc. The atropine mixture and the olive oil being given as before the other two feeds.

At 8 *and* 10.30 *a.m., noon,* 3, 5.30, 8.30, *and* 10 *p.m.* Five ounces of citrated, creamy milk.

Additional drugs. Half a teaspoonful of magnesium trisilicate in water half an hour after each of the four meals and again at 9 p.m. A teaspoonful of the atropine mixture at 10 p.m. The bowels should be regulated by giving one teaspoonful to one tablespoonful of paraffin once or twice a day, and magnesium hydroxide (B.P.) or milk of magnesia—one teaspoonful with one or more of the milk feeds.

STAGE 3.—POST-ULCER REGIME

One must make sure that the patient understands that ulcers heal very slowly, that they tend to recur, and that he must be very cautious

about making any changes in his diet. When he is ready for discharge from the hospital or nursing home, explicit instructions must be given to him with regard to his diet and the general care of his health. Many hospitals have printed leaflets that can be given to the patient, outlining a few 'Do's' and 'Don't's' to be observed permanently. That arranged by Hurst is as follows:

Avoid all pips and skins of fruit, raw, cooked or in jam; also currants, raisins, and lemon peel in puddings or cakes, nuts, and all unripe fruit. Figs are particularly undesirable. Orange juice may be taken or the orange sucked, but the pulp should not be eaten.

Avoid all raw vegetables, such as celery, tomatoes, cucumber, and watercress. Spinach is not allowed, but other green vegetables may be taken provided that they are passed through a sieve and mixed with butter, in the form of a purée. Porridge, if taken, must be made of the finest oatmeal.

Avoid vinegar, lemon juice, and sour fruit; pepper, mustard, chutney, curry, pickles, and any excess of salt; new bread, cooked cheese, tough meat, pork, all made-up and fried foods, high game, and clear and thick meat soups. During the first six months after recovery it is better to avoid meats altogether.

Avoid effervescing drinks and coffee, except dandelion and other herb coffees. Take no alcohol at first. If desired later on, a small quantity of light wine or diluted whisky may be taken at meals.

Take a tablespoonful of olive oil before each meal, and take as much butter and cream as possible.

Take 15 grains—or a teaspoonful of the mixture—of magnesium trisilicate half an hour after meals and also directly the slightest indigestion or heartburn is felt. If the acidity curve remains high the atropine mixture should be taken before meals and the last thing at night.

The bowels should be kept regular by means of magnesia and liquid paraffin, but no other aperients should be taken. No drugs must be taken in tablet form.

Eat slowly and chew very thoroughly. An adequate time should be allowed for meals, and meals should be punctual. Rest for a quarter of an hour before and after each meal.

Visit the dentist every six months so as to ensure that the teeth are in good condition.

Do not smoke excessively, and not at all if there is any indigestion.

For the first six months, not more than two hours should elapse between meals or a feed of milk, plain chocolate, or a plain biscuit, from waking till retiring; a small feed being taken if awake during the night. After six months of complete freedom from symptoms, one feed should be taken in the middle of the morning, on going to bed, and if awake during the night, in addition to breakfast, lunch, tea, and dinner. If there is the slightest return of symptoms, go to bed on a strict diet and consult the doctor.

Special care should be taken to avoid chills, sore throat, influenza, or other infection. If any of these occur, go to bed on a very light diet until recovery is complete.

It may be felt that it is better to tell the patient more about the things he *may* eat than to give too many details of things that he must avoid. For example, he should try to take two pints of milk each day, use butter and margarine freely, take eggs in any form except fried; he may have tinned or cooked fruits if he avoids pips and skins, and green vegetables if they are finely chopped or passed through a sieve; and porridge if made with fine oatmeal or strained.

DANGERS AND DEFICIENCIES OF STRICT GASTRIC DIETS

Patients on these diets for some considerable time run a risk of developing avitaminosis or alkalosis unless some steps are taken to avoid these complications. Vitamins A and D are supplied in adequate amounts in the milk, butter, and eggs. Those of the B complex may be inadequate because all coarse grains and husks are forbidden, and vitamin C is often inadequate because of the limitation of fresh fruits and vegetables, especially when raw. An iron-deficiency anæmia may occur, especially if there is hæmatemesis or melæna. To avoid these deficiencies, Marmite may be added to milk or be used in sandwiches, in order to supply vitamin B; and ascorbic tablets may be crushed for addition to feeds in order to supply vitamin C when the patient is not taking much orange juice or other fresh fruit juice. For iron deficiency the physician will order some preparation of medicinal iron.

Alkalis are not only the most used remedy in peptic ulcer but they are also the most abused, for they give immediate relief from discomfort and pain in most forms of hyperchlorhydria. Proprietary brands

of alkali powders are much advertised, they are purchased freely by the general public, and are used indiscriminately without consulting a physician, with the result that in a susceptible person a condition called *alkalosis* may develop. It can also develop in a patient undergoing treatment. Only the amount of alkali actually needed to minimize free acidity should be given. The kind of alkali may vary. Those given most freely in the past were bismuth, magnesium and calcium carbonate, sodium bicarbonate, and sodium citrate. The less soluble and readily absorbed alkalis, such as magnesium trisilicate, tribasic calcium phosphate, and colloidal aluminium hydroxide are to be preferred. At the present time, when alkali is needed it is usually prescribed in the form of magnesium trisilicate, for this does not cause alkalosis. It reacts with hydrochloric acid to form magnesium chloride and colloidal silica, which acts as an adsorbent.

Patients who have some organic renal disease, as well as those who are unduly susceptible to alkalis, are the most prone to develop alkalosis. The chief symptoms are headache, nausea, vomiting, and drowsiness. In severe cases the condition may resemble that of uræmia. In all patients taking alkalis regularly the urine and blood chemistry should be watched. Albumen may be found to be present in alkaline urine and the blood urea is raised—in severe cases up to 300 mg. per cent[1]; whilst the chloride content is lowered. The treatment for alkalosis is to stop the giving of alkalis and to give normal saline solution freely by mouth, rectum, or even intravenously if coma threatens.

DIET AFTER HÆMATEMESIS AND MELÆNA

The general principle that nothing was to be given by mouth during the first 24 to 48 hours after a hæmorrhage from a peptic ulcer was accepted by most physicians until 1933, when it was challenged by E. Meulengracht. He published the results of immediate feeding with a somewhat varied diet, and showed that the mortality was less than with an initial period of starvation, that nutrition was maintained, loss of weight prevented, convalescence shortened, and blood regeneration speeded up. Meulengracht gave five meals on the first day and six on the second and subsequent days, arranged as follows:

[1] This means 300 milligrammes per 100 cubic centimetres.

MEULENGRACHT DIET

First day

6 a.m.	White bread and butter, with tea.
9 a.m.	Oatmeal with milk, white bread and butter.
1 p.m.	Puréed vegetables, such as peas and carrots, mashed potato, white bread and butter, tea.
3 p.m.	Cocoa or tea with milk.
6 p.m.	Mashed potato, puréed vegetables, custard, white bread and butter, tea.

Second day

6 a.m.	Tea, white bread and butter.
9 a.m.	Oatmeal with milk, white bread and butter. Cocoa or tea.
1 p.m.	Cream of vegetable soup, using peas, potato, carrots, runner beans or asparagus, boiled or mashed potato, puréed vegetables.
	Cooked and strained fruit, plain rice or tapioca pudding, junket or chocolate cornflour mould.
3 p.m.	Cocoa or tea with milk.
6 p.m.	Cream cheese or eggs, soft boiled or poached, boiled or mashed potato, or cereal with milk and sugar.
9 p.m.	Puréed vegetable, dessert from above list, white bread and butter.

Thereafter, such additions as meat balls, broiled chops, omelets, fish balls, fish gratin, stewed apricots, and baked apple are made gradually, the patient being allowed to have as much as he wishes.

In 1937 Professor Witts introduced a modification of Meulengracht's diet which is now widely used in this country. It includes eight two-hourly feedings during the day for the first three days, with extra feeds at night, if awake.

The advantages claimed for such a diet are that the anæmia resulting from a severe hæmatemesis improves much quicker than it would do if the patient were given parenteral fluids or any form of milk diet, and he is not unduly depressed by dietary restrictions. Dehydration is prevented and it is an added advantage if the patient can maintain his intake of Calories, minerals, and vitamins. The more solid articles of food should, however, be given only to those patients

WITT'S MODIFICATION OF MEULENGRACHT'S DIET

Time	*Foods Given*	*1st day*	*2nd day* *Amounts*	*3rd day*
7 a.m.	Whole milk, fresh or dried	5 oz.	5 oz.	5 oz.
	Patent barley or strained porridge	1 portion	1 portion	1 portion
9 a.m.	One egg beaten up with milk	5 oz.	5 oz.	5 oz.
	Buttered rusk or cream crackers	—	1 ,,	2 ,,
11 a.m.	Whole milk, fresh or dried, with Marmite	5 oz.	5 oz.	5 oz.
	Barley sugar	,,	1 ,,	1 ,,
	Thin, crustless white bread and butter	—	1 slice	2 slices
1 p.m.	Strained orange or tomato juice	1 oz.	1 oz.	1 oz.
	Vegetable purée	1 portion	1 portion	1 portion
	Milk pudding	,,	,,	,,
	Cream	1 oz.	1 oz.	1 oz.
	Boiled or steamed fish	—	—	1 portion
3 p.m.	As 9 a.m., with addition of barley sugar	1 oz.	1 oz.	1 oz.
5 p.m.	Whole milk, fresh or dried	5 oz.	5 oz.	5 oz.
	Fruit purée	1 portion	1 portion	1 portion
	Milk pudding or cornflour mould	,,	,,	,,
	Cream	—	1 oz.	1 oz.
	Thin crustless white bread and butter	—	1 slice	1 slice
7 p.m.	One egg beaten up in milk	5 oz.	5 oz.	5 oz.
	Black treacle or barley sugar	1 oz.	1 oz.	1 oz.
	Buttered rusks or cream crackers	—	1 ,,	2 ,,
9 p.m.	Whole milk, fresh or dried	5 oz.	5 oz.	5 oz.
	Fruit purée	1 portion	1 portion	1 portion
	Pudding	,,	,,	,,
During night if awake	(1) Whole milk	5 oz.	5 oz.	5 oz.
	(2) One egg beaten up in milk	5 ,,	5 ,,	5 ,,
Between feeds	Strained orange or tomato juice	1 oz.	1 oz.	1 oz.
	Approximate Calorie value =	2,545	3,118	3,624

who are able to masticate properly, for it is most important that the food should enter the stomach in the right condition for gastric digestion. The efficiency of the diet is checked by weighing the patient each week.

CONTINUOUS DRIP-FEEDING

When in spite of adherence to a rigid first-stage gastric diet a patient with peptic ulcer still complains of severe and persistent pain and is irritable and restless, the inference is that the ulcer is unusually deep and penetrating into the muscular wall. The liability to hæmorrhage and perforation is then great. All vomited matter and fæces should be saved for inspection by the physician and be sent to the laboratory if a test for occult blood is required. The amount of urine passed each day should be recorded, together with its specific gravity, in view of the possibility of dehydration.

Continuous drip-feeding may be ordered, and this may be gastric or duodenal. If there is little or no vomiting, a long, fine tube may be passed through either the nose or the mouth into the œsophagus and thence into the stomach; and the feed can then be allowed to run in slowly and continuously from a bottle suspended from the head of the bed. The feed could consist of milk, cream, glucose, and beaten-up egg, strained in order to prevent blocking of the tube. To make up the vitamin content, 100 cubic centimetres of orange juice, 15 cubic centimetres of cod liver oil, and two teaspoonfuls of brewer's yeast may be added in the twenty-four hours. When orange juice is not available crushed ascorbic acid tablets may be substituted. These tablets may contain 5, 25, or 50 milligrammes, according to size. The patient should receive not less than 50 milligrammes a day. The brewer's yeast supplies the very important vitamins of the B complex. Aneurin is particularly necessary when glucose drip feeds form the only kind of nourishment taken, for without it intermediate products of carbohydrate metabolism accumulate in the blood and may cause nausea, vomiting, intestinal distension, and paralytic ileus.

When a continuous drip is given the rate of flow should be from 30 to 40 drops a minute, which gives a total of from 4½ to 6 pints in the twenty-four hours. The motility of the stomach is thus reduced to a minimum and pain is relieved, the ulcer is covered with an acid-

neutralizing food and the patient's nutrition is maintained, which, in view of the possibility of the occurrence of a serious complication, is most important.

If the patient strongly dislikes the tube, or complains of a sore throat owing to its medial position in the pharynx, the milk drip might be given during the night only. The tube is then removed in the morning and the Hurst diet—first stage—is given during the day.

If vomiting is intractable, or it is necessary to maintain the stomach at complete rest, duodenal feeding may be required. Nurses are often at a loss to know how they can ascertain, without recourse to X-ray, that the tube *is* in the duodenum and not curled up in the stomach. A Ryle's weighted duodenal tube is required, and this is first passed into the stomach. The patient is then placed on his right side, is made comfortable and, if his condition permits, is given an interesting book to read or other pleasant occupation is provided that will divert his mind and overcome his nervousness. In half an hour to two hours the movements of the stomach should cause the tip of the tube to pass through the pylorus. Its progress may be ascertained by aspirating a little fluid from the tube from time to time. When yellowish fluid having an alkaline reaction is obtained the tube is *probably* in the duodenum, but it is possible that intestinal fluid is regurgitating into the stomach. The position of the tube can be verified by giving the patient a little red-coloured fluid such as cochineal in water to drink and then immediately aspirating a little fluid from the tube. If the aspirated fluid is coloured red the tube is still in the stomach, but if bile-stained fluid is obtained it is in the duodenum. If the tube has not passed through the pylorus it is possible that this sphincter is in spasm, and to overcome the spasm the physician may order the stomach to be washed out with plain water, and then 5 minims of tincture of belladonna in half an ounce of water may be run in through the tube or a hypodermic injection of atropine sulphate may be given.

When it is ascertained that the tube is in the duodenum the continuous drip-feed may be started, but all food that misses the gastric stage of digestion must be peptonized.

CHAPTER 15

DIET IN INTESTINAL DISORDERS

The disorders of the intestines that require dietary treatment are mainly those associated with constipation or diarrhœa, but these two conditions must be regarded as symptoms rather than diseases and in each case the underlying cause must be sought and treated, where possible.

CONSTIPATION

Constipation is by far the most common disorder of the digestive tract and it may be defined as stasis, or stagnation, of material in the intestinal canal, chiefly in the colon, which results in an abnormal delay in the passage of fæces. The causes of constipation may be either functional or organic. Of the functional, two types are recognized—atonic and spastic. Obstructive constipation is organic in origin. It is less common but more serious than functional constipation.

ATONIC CONSTIPATION

This is the most prevalent type of constipation. Its chief cause is a faulty diet, which may be too dry, may lack bulk, or be deficient in vitamins and minerals, particularly potassium salts. The results of the dietary faults are aggravated by sedentary occupations, nervous strain, worry, and neglecting to maintain a habit of daily bowel evacuation.

The loss of tone of the bowel results in weakness of its muscular contractions, so that the peristaltic movements that should propel the fæcal mass through the colon are slowed down. This may occur in chronic invalidism, obesity, or pregnancy, or it may be due to lack of vitamin B. The chief stimulus to peristalsis is pressure within the lumen of the bowel. The taking of a diet that is almost completely

digested and absorbed in the small intestine leaves too little residue to provide the necessary stimulus. Insufficient fluid intake renders the residue dry and hard and its passage then becomes difficult. Many of our modern foods are purified and concentrated and are devoid of the natural remedial agent for atonic constipation—which is the cellulose of vegetable foods, for not only does this form an indigestible residue but it absorbs liquid in its passage through the intestines. Also, the organic acids in fruits and vegetables act as peristaltic stimulants, and the germ of cereal foods—which is usually removed with the husk when the grains are polished—contains vitamin B which is most necessary for the maintenance of the general tonicity of the intestinal walls. Fats, oils, and sugars also act as mildly laxative factors.

The taking of a fairly large amount of fluid and solid food into the stomach results in a reflex stimulation of the colon, so that the desire to empty the bowels will normally occur soon after a meal. Since the most convenient time for this to happen is after breakfast, special attention should be given to the composition of this meal. Hot or cold water taken on an empty stomach is a powerful stimulant of reflex contraction of the colon, and seeing that it is only in the early morning that the stomach and small intestine are empty a glass of water should be taken on awaking.

A suitable morning diet for a person with atonic constipation might be a glass of cold water on waking, followed ten minutes later by a cup of tea, and another glass of cold water on going down to breakfast. This meal should start with fruit, such as stewed prunes or figs or, if procurable, an orange or half a grapefruit. Then coarse oatmeal porridge or bran flakes with milk, cream, and sugar. Wholemeal bread, which can be toasted or not as desired, with butter, marmalade, or honey; and two or three cups of tea or coffee should be taken. Other breakfast dishes could be included if desired.

After breakfast an attempt should be made to evacuate the bowels. During the morning two glasses of cold or hot water could be taken, and beer, cider, and table waters are allowed. At lunch and dinner, water, vegetables, and fruit should be freely included. Tea might consist of Ryvita or Vita-wheat biscuits and butter with several cups of tea. The articles to be avoided are white bread and foods made with white flour or highly milled cereals, potatoes, fried foods, pastries and cakes, clear soups, and strong tea. Exercise, correct

posture, and abdominal massage are helpful adjuncts in correcting atonic constipation. Purgative drugs should be avoided but two inert substances are frequently prescribed—liquid paraffin and agar-agar. Liquid paraffin, which is a non-absorbable mineral oil, does not add bulk but it acts as a non-irritating lubricant. Its main disadvantage is that it tends to leak out from the anus and soil the clothing; this can, however, be avoided if the paraffin is given immediately after a meal. Agar-agar is a dried preparation made from seaweed. It can be given in shredded form or as a powder, the dosage being one teaspoonful or more according to the patient's need. It is non-absorbable but it takes up a large amount of water, forming a soft, bulky mass. It is sometimes made into an emulsion with liquid paraffin. Many proprietary preparations of agar-agar, however, contain a purgative drug which is to a large extent responsible for their action, whilst the percentage of agar-agar is relatively small.

SPASTIC CONSTIPATION

This is due to increased tonicity of some portion of the intestinal tract and is thus a very different condition from atonic constipation. The over-activity is particularly in the colon, but the contraction of the muscular wall is spasmodic, causing a block in the passage of the food residue in its downward course. The spasmodic contractions are usually accompanied by pain. The stools are small, dry, flattened, and combined with mucus, or they may be small, hard masses. Spastic constipation, or colon spasm, is frequently of nervous origin, particularly affecting people with highly strung neurotic temperaments. It may, however, result from irritation of a chemical or mechanical nature—from the excessive use of tea, coffee, alcohol, condiments, or spices, or from the taking of very coarse foods. The long-continued use of purgatives or enemata is a contributory cause. On X-ray examination after a barium enema a marked constriction of the descending colon may be seen, whereas in atonic constipation this portion of the colon often shows ballooning.

Whatever, the cause the dietary treatment aims at reducing any source of irritation that may cause colon spasm and the provision of sufficient bulk to prevent stagnation of food residue in the large intestine. In the beginning of the treatment it may be necessary to give semi-liquid or soft solid food containing little or no cellulose,

such as milk, eggs, malted milk, orange or grapefruit juice, with a very little white bread, preferably toasted. Butter and oils are good; in fact, liquid paraffin may be prescribed in small doses. Gradually, vegetables, fruits, and cereals that are low in cellulose are added, no pips, skins, or seeds being taken. Suitable foods include spinach, carrots, beet, cauliflower, mashed potatoes, sieved tomatoes, milled cereals, sieved fruits, and tender meat or fish, chopped or scraped to remove fibre. All food should be taken at moderate temperature, for if too hot or too cold a reflex contraction of the colon may take place. It is essential that vitamins A, B, and C should be adequate, for they improve the condition of the membranes lining the intestinal tract and render them less susceptible to irritation.

When the spasticity of the colon has improved, the foods giving a residue may be increased but the character of the diet must remain smooth and bland for at least a year. Five or six small meals daily are better than three large ones; but the patient must eat sufficient to maintain his weight, or to show a steady gain if he is underweight, as patients with spastic constipation usually are at the commencement of treatment. Purgatives and enemata must be avoided. The taking of small amounts of liquid paraffin or of agar-agar jelly, with sufficient exercise to keep the body in good condition, should be all that is necessary to ensure satisfactory bowel action if the dietary directions are followed. The diet suggested for spastic constipation is suitable for other conditions following irritation of the intestinal tract; for example, when a patient is recovering from an attack of diarrhœa or is convalescing from ulcerative colitis.

VISCEROPTOSIS

This condition is often present in the same type of patient as those who suffer from spastic constipation. It is characterized by an abnormally low position of the abdominal organs. It may follow a fall in intra-abdominal pressure, such as occurs after pregnancy when insufficient attention is given to the restoration of tone of the abdominal muscles, and after repeated abdominal operations or any long and exhausting illness. There is, however, a type of person with a particular physical build who is specially liable to develop visceroptosis—the rather tall, thin person with a narrow chest, a long, narrow costal angle and a tendency to lordosis, and who easily becomes

mentally and physically exhausted. In this group a neurotic tendency is present from the very outset of the condition, whereas in the former group it develops as the physical condition becomes established.

At the beginning of the treatment the patient should remain in bed. He or she is usually exceedingly thin and an improvement in nutrition is essential to an increase in the intra-abdominal supporting fat and an improvement in general condition. These patients usually have poor and somewhat capricious appetites. The diet for spastic constipation is suitable but extra nourishment should be given between meals in the form of fortified milk, milk flavoured with tea, coffee, cocoa, chocolate, or anything else the patient fancies, junket, egg flip, or ice cream. Butter should be given as freely as possible. As soon as the patient's general condition shows improvement and there is a satisfactory gain in weight, massage and suitable exercises are employed to restore the tone of abdominal muscles. Certain forms of mechanical support—such as a Curtis belt—may be necessary for some time after the patient gets up.

OBSTRUCTIVE CONSTIPATION

This may be partial or complete, acute or chronic. It may be caused by adhesions, kinks, impaction, Hirschsprung's disease or megacolon, pressure of a tumour either within or outside the intestinal wall, rectal prolapse, hæmorrhoids or anal fissure. If possible, surgical treatment is carried out, but in inoperable cases the modification of the diet aims at keeping the patient as comfortable as possible and promoting or maintaining a satisfactory standard of nutrition. The diet is arranged on much the same lines as for spastic constipation, but residue must be reduced to a minimum and all gas-forming foods excluded. Carbohydrates are apt to ferment and to produce gas, and foods that decompose easily, such as meat and meat products, are contra-indicated. It may be necessary at times to exclude plain milk, substituting buttermilk or one of the cultured milks. Malted milk with lactose may be tolerated when other milks give rise to flatulence.

DIETARY TREATMENT OF FLATULENCE

There are two main causes of flatulence—abnormal fermentation in the gastro-intestinal tract and the swallowing of excessive amounts

of air with food or drink, or even between meals; a habit known as *aerophagy*. The latter is very common and the patient is usually unaware that he has developed such a habit. An explanation may be of considerable value in helping him to overcome it. He should be advised to eat and drink carefully and slowly, taking fluids before and after a meal rather than with it. A charcoal biscuit slowly masticated after meals causes absorption of some of the swallowed air and thus limits discomfort from the resultant flatulence.

In the older person flatulence may be an early sign of obstruction from carcinoma of the large intestine, or even of a failing heart.

When due to fermentation of foods it is desirable to restrict carbohydrates and substitute lactose or glucose for ordinary cane sugar. Foods such as onions, cooked cabbage, radishes, fried, fatty or rich foods or dried beans may cause flatulence, and so also may overeating, cholecystitis,and any form of constipation. It may be a prominent cause of discomfort in the early stages of treatment for atonic constipation, since the diet contains a high proportion of cellulose and other carbohydrates. The relief of the constipation as the patient perseveres with his diet and associated treatment will also relieve the flatulence. If there is no atonic constipation, a moderately low residue diet is indicated. The taking of 1 to 3 drops of oil of peppermint in a little water at the conclusion of a meal, or the sucking of a soda-mint tablet, may help during the early stages of treatment, but it should be discontinued as soon as the flatulent tendency has subsided to the point where discomfort is not excessive.

DIARRHŒA

Diarrhœa may be defined as a morbid frequency in bowel action due to errors of diet or irritation and inflammation of the mucous membrane lining the intestines. There is an abnormally rapid passage of fluid along the alimentary tract, thus preventing complete digestion and absorption. Stools are not only increased in number but also in water content. If the seat of the trouble is in the upper part of the tract, fragments of food may be present in the stools; if in the lower portion there may be an excessive amount of mucus or even blood present.

Two main types of diarrhœa are recognized—the one associated with excessive fermentation and the other with excessive putrefac-

tion. The dietary treatment of diarrhœa aims at eliminating all sources of irritation and stimulation, promoting the healing of the inflamed mucous membrane, and restoring the normal function of the intestinal tract. In addition, pain, dehydration, emaciation, and collapse must be prevented or treated.

When an acute attack of diarrhœa is due to the ingestion of some irritating food or other substance, the administration of 1 to 2 drachms of castor oil causes the elimination of the offending materials by purgation. Alternatively, one can give a powder that will cause adsorption of the irritant substances. Kaolin powder in doses of 1 to 2 drachms suspended in water at half-hourly intervals until the diarrhœa is checked, some preparation of bismuth or a mixture of charcoal and chalk, such as Mistura Cretæ, B.P.C., may be ordered. These substances are also astringent and they form a coating upon the inflamed membrane. The giving of preparations containing opium to check the diarrhœa by lessening intestinal movement is not favoured, for the irritating or toxic substances may then be absorbed and cause symptoms that are more serious than the diarrhœa itself.

Having cleared the intestinal tract of irritating material, a period of starvation lasting from 12 to 36 hours is required to rest the inflamed tissues. During this time only weak tea, fat-free broth, plain water, barley water, and lemonade with sugar may be given by mouth, and it is well to include some form of vitamin B concentrate. The starvation period is followed by the giving of foods that leave little residue in the intestines. The bland, smooth diet that is recommended for spastic constipation is suitable and it bridges the gap until a normal diet can be resumed. Fats, because of their lubricating action, are restricted until bowel action is normal.

If the disorder lasts for more than a few days, two other aspects of the condition need consideration—the loss of weight from starvation and the dehydration resulting from the loss of water by the bowel. Glucose must be given to prevent ketosis as a sequel to the starvation and also to improve muscle tone, for it is a concentrated food which is completely absorbed in the upper part of the intestine. It can be given in orange juice, lemonade, or barley water and also in weak tea or coffee, adding a vitamin B concentrate to assist the metabolism of the glucose and to reduce the liability to gaseous distension.

Diarrhœa lasting for a week or more demands that some attempt

is made to improve the Calorie intake, or loss of weight will ensue that will cause the period of convalescence to be unduly protracted. Raw eggs, boiled milk, cream, sugar, and orange juice, given in two-hourly feeds with water between feeds as desired, may prove suitable or it may cause nausea and abdominal distension. Semi-solid food, such as junket, egg custard, milk puddings, Benger's food, gelatine preparations such as Brand's essence, and lightly boiled or poached eggs with a little bread and butter may be more acceptable to the patient.

Some types of diarrhœa which persist over a comparatively long period and require special dietary consideration are cœliac disease, sprue, and colitis.

CŒLIAC DISEASE, OR GEE'S DISEASE

This is a disturbance of intestinal function that may occur in children as young as six months of age, although its onset is much more common during the second year of life. It appears to result from an inability to absorb fats, even after these have been digested. Carbohydrates tend to ferment and form gas, which still further interferes with fat assimilation, and mineral salts pass through the alimentary tract and are carried out of the body as a result of defective absorption processes. The disease is characterized by recurrent attacks of acute diarrhœa, in which the stools are bulky, semi-fluid, pale, frothy, and very offensive. The quantity is often three times the amount passed by a child in normal health, but the abdomen becomes distended and tympanic. There is loss of weight, with retarded growth in height, anæmia, anorexia and vomiting, loss of muscle tone, especially of the trunk, and fretfulness, irritability, and fatigue as a result of the low sugar and fat content of the blood. The development of the bones is impaired owing to the loss of calcium and phosphorus.

DIETARY TREATMENT

A new treatment has recently been suggested, but hitherto this disease has required careful dieting, excluding fats and limiting carbohydrates, up till the age of six years in order that normal function might develop. Few of the general principles of infant feeding can be

followed, for proteins must form the basis of the diet, and skimmed or dried milk is better tolerated than fresh milk.

In the first stage, protein milk sweetened with saccharin forms the sole diet. Protein milk is made by preparing junket in the usual way, and after it has stood for 35 to 40 minutes it is drained slowly through double gauze, the curd being gently broken but not squeezed. When all the whey has escaped, the curd is rubbed through a sieve with the very gradual addition of boiled water, buttermilk, or Ringer's solution. It may be obtained commercially in dried powder form, and this simplifies the preparation of the feeds. It can be reconstituted with Ringer's solution, and as this is an isotonic fluid containing sodium, potassium, and calcium chloride, it assists in compensating for the loss of mineral salts by the bowel. Four to six feeds are given daily, with ample water to drink between feeds. If anorexia is marked, the feeds may be flavoured with cocoa, essence of vanilla, orange or other suitable flavouring which the child may like.

After a few weeks the diet may proceed to the second stage, with the addition of small but increasing quantities of lean beef juice, cheese made from skimmed milk, scraped beef, shredded chicken or white fish, and the white of egg. If the child dislikes protein milk, half of it may be replaced by an equivalent quantity of dried, skimmed milk. Thirty drops of halibut liver oil may be ordered daily, and also orange juice and some preparation of iron. The protein milk is increased in quantity as the months go on. The weight should improve under this diet and the distension should not increase.

The third stage of the dietary is reached when the child is about three years old. Well-ripened bananas are then a particularly valuable addition. Beginning with half a banana daily, more can be introduced until four to six are taken in the twenty-four hours. A few months later puréed vegetables in small quantities may be tried, but children differ as to which vegetables are best tolerated; carrots, runner beans, tomatoes, spinach, and cauliflower are often found suitable, and puréed apple can also be given. Gradually, well-cooked cereal and toast may be added, and very cautiously the diet can be worked up approximately to that given to a healthy child. Premature additions to diet may cause a relapse, and so also may an intercurrent infection. In this event the first-stage diet should be resumed without delay.

The recent development in the treatment of cœliac disease involves

the intramuscular injection of liver extracts and of the B complex vitamins on alternate days, following which the rate of recovery is reported to be speeded up, a real improvement occurring within six weeks. In the light of further research the effectiveness of this treatment has been ascribed to the folic acid content of the vitamin B complex and the fact that this substance is thought to be synthesized in the intestine and stored in the liver.

SPRUE, IDIOPATHIC STEATORRHŒA OR GEE-THAYSEN'S DISEASE

Two forms of sprue are described—tropical and non-tropical sprue, the latter also being called idiopathic steatorrhœa or Gee-Thaysen's disease. It is claimed by some authorities that non-tropical sprue is the adult form of cœliac disease, but the treatment of the two types of sprue does not differ in any important respect.

Medical opinion varies as to whether it is a gastro-intestinal infection or a disorder of digestion and absorption. In some respects it appears to be allied with pernicious anæmia. In a characteristic case the tongue and mouth are so sore that eating is difficult. Several stools are passed each day and they may be soft and mushy in consistency or foamy and light-coloured with a very sour odour. They contain a high percentage of fatty acids and saponified fat. The abdomen is distended and drum-like. Loss of weight and anæmia are marked symptoms. Calcium metabolism is impaired and in late stages osteomalacia may occur.

The diet should contain a high percentage of protein because fats are poorly assimilated and starches are not well tolerated. Scraped beef or liver, lamb or poultry are suitable proteins. The form of carbohydrate contained in strawberries and bananas can be well utilized; and orange and tomato juice are recommended. Milk, but not cream, may be given freely. A special diet suggested for sprue starts with three pints of milk in twenty-four hours, given in two-hourly feeds, and this quantity is increased up to six pints as the patient improves, varying the monotony by giving malted milk and Benger's food. After about six weeks, some of the milk is replaced by white of egg, arrowroot, toasted white bread, and biscuits. Strawberries may be given up to 2½ pounds a day. Twelve ripe bananas are allowed daily, and these can be used as a substitute for bread and potatoes. Liver extract is needed to combat the anæmia,

and calcium compounds with vitamin D in tablet form is prescribed to prevent bony changes. Throughout the treatment glucose and saccharin are to be preferred to sugar.

A dried, defatted, high-protein milk product—prepared by the Cow and Gate Company and known as *Sprulac*—is often found to be more suitable than ordinary milk in the treatment of sprue, especially in the tropics. It is free from bacteria, its vitamins are unimpaired, and its composition is adjusted to meet the requirements of the patient, the fat and carbohydrate content being low. The ratio of protein, carbohydrate, and fat is 1·0, 1·3, 0·3, and the Calorie value of 1 ounce of the dried product is 125. The actual composition is given as: Protein 34 per cent, lactose 45 per cent, fat 10·6 per cent, mineral salts 7·4 per cent, water 3 per cent. A five-stage diet is recommended with the use of Sprulac.

Stage I. One ounce of Sprulac made up with 8 to 10 ounces of water every two and a half hours for six feeds daily—supplying 750 Calories.

Stage II. One and a half ounces of Sprulac with 8 to 10 ounces of water every two and a half hours for six feeds, the juice of an orange, and 1 oz. of calves' foot jelly = 1,200 Calories.

Stage III. Two ounces of Sprulac with 12 to 16 ounces of water every two and a half hours for six feeds, the juice of two oranges, and 2 ounces of calves' foot jelly = 1,640 Calories.

Stage IV. Sprulac as for stage III, the juice of two oranges, 3 ounces of calves' foot jelly, 2 ounces of baked custard or two baked apples and one rusk, and 4 ounces of underdone tender lean beef = 2,100 Calories.

Stage V. As stage IV with the addition of 6 ounces of underdone beef and one rusk—making 10 ounces of beef and two rusks daily = 2,600 Calories.

If the progress is satisfactory there will be a diminution of diarrhœa, intestinal flatulence, and distension, and the character of the stools will improve. During convalescence a more liberal diet is allowed, and this may include the following foods:

Soups—made of meats, vegetables, legumes and eggs, or meat cubes.

Cereals—those low in starch and that require cooking, such as rice, tapioca, oatmeal, and farina.

Meats—beef, poultry, veal, pork, liver, pancreas, kidney, brains; also eggs and boiled fish.

Vegetables—artichokes, asparagus, beans, cauliflower, celery, endive, leeks, lettuce, mushrooms, spinach, tomatoes, and watercress.

Fruits—melon, cantaloupe, lemon, orange or grapefruit, rhubarb, blackberries, strawberries, bananas, and peaches.

Beverages—Coffee, tea, cocoa, mineral waters, and alkaline waters.

The articles to be avoided are overdone or twice-cooked meat, food cooked or fried in fat, condiments such as pepper, mustard, chillies, sauces, chutney, curries and spiced foods, duck, salmon, trout, mackerel and herring, salad dressing, new bread, cakes, pastries and icing, suet pudding, sweets, chocolate-alcoholic drinks, and aerated waters.

Smoking is allowed in moderation when the convalescent stage is reached.

The latest treatment for sprue is the administration of folic acid—a factor in the B vitamin complex. A series of cases has been successfully treated by T. D. Spies, in Alabama, and it is reported that not only did the anæmia disappear but the liquid, fatty stools became solid brown fæces after a few days.

COLITIS

This disease may be functional or organic in origin. The functional forms are simple colitis and mucous colitis; whilst ulcerative colitis is an organic form.

Simple colitis may be due to the excessive use of purgatives or enemata, to unsuitable foods or food habits, or to disorders of the nervous system. At times, constipation of a spastic type may precede the attacks of diarrhœa. The diet must be adapted to the symptoms present. Generally speaking, at first it should be free from roughage, spices, and other irritants, but later a rather soft bland diet of high Calorie value is indicated.

Mucous colitis is characterized by constipation and the passage of large quantities of mucus and shreds of membrane, sometimes accompanied by severe colic. The dietary treatment is on the same lines as for simple colitis.

Ulcerative colitis is associated with severe diarrhœa and the passage of mucus, blood, and pus in the stools. Emaciation, fever, and other general symptoms are present. Several forms of dietetic

treatment are advocated, probably dependent upon the symptoms that are most pronounced. These diets may be a bland, low-residue diet, a high-residue diet or a high-Calorie diet. The choice depends upon three main factors—the severity of the inflammation and ulceration of the colon, the patient's ability to tolerate food, and the progress he makes in developing his tolerance for food. Treatment is of long duration, and transition from one stage to another depends entirely upon the condition of the patient and it must be at the discretion of the physician; the greatest care being exercised to prevent a relapse or a recurrence of the disease. If diarrhœa is very severe, temporary benefit often follows a diet of pulped apple, but this cannot be continued for more than a few days owing to its low Calorie value.

CHAPTER 16

DIET IN DISORDERS OF THE LIVER AND GALL BLADDER

The part played by the liver in the digestion and assimilation of food is as follows: The glucose resulting from carbohydrate digestion is formed into insoluble glycogen and stored until it is required by the tissues, when it is hydrolysed into glucose once more. The secretion of the liver—bile—helps with fat digestion and absorption from the small intestine, stimulates peristalsis and limits bacterial activity in the large intestine. The liver brings about certain changes in fats so that they can be utilized as fuel or be stored in the various fat depots of the body. With regard to amino-acids, which are the end products of protein digestion, the liver disposes of any excess by converting the nitrogenous portion into urea, leaving the remainder to be stored or used as a carbohydrate or a fat. It has a detoxicating effect upon the blood, especially upon substances produced by bacterial action or taken in food, and upon uric acid and various drugs. The conversion of worn-out red blood-cells into bile pigments and the storage of the iron content of the released hæmoglobin takes place in the liver. With regard to vitamins, the liver converts carotene into vitamin A and stores it. Vitamin D is also stored in the liver, hence the high content of these two vitamins in fish liver oils and in mammalian liver. The liver function in the production of prothrombin, which gives the blood its coagulating quality, requires the presence of vitamin K and of certain constituents of the bile. In biliary disturbances wherein conditions prevent the flow of bile into the intestine, vitamin K is not absorbed from the foods that contain it, and even in the presence of bile it is not absorbed in conditions such as sprue and idiopathic steatorrhœa, when the power of the intestinal mucosa to absorb fat is reduced.

About two pints of bile are secreted daily by the liver under the stimulus of food intake or as a result of a psychic stimulus. There is little secreted during fasting. The gall bladder concentrates bile four

to ten times, by the absorption of water, and then acts as a storehouse for the concentrated product, thus maintaining a small reserve supply to meet the immediate needs of digestion. The greatest stimulants of biliary activity are foods containing fats, next come proteins, whilst carbohydrates appear to have little or no action upon the flow of bile. Certain drugs stimulate this function and so also do the bile salts, which are reabsorbed from the intestine and returned to the liver to be used again.

From this résumé of liver function it is obviously important that the healthy condition of the liver and gall bladder must be maintained if efficient digestion and utilization of food is to proceed. It has been shown that when the liver cells have adequate stores of glycogen they are less liable to injury or infection than when these stores are depleted. Protein is also necessary for the protection of the liver and for the repair of hepatic cells; and the amino-acid methionine, which is present in milk protein and hence in cheese, has the power to prevent fatty degeneration of liver cells. Recent advances in nutritional science have suggested that the protein restriction that was a feature of the special diets for liver disorders was probably wrong, if for no other reason than that the liver plays an important part in the production of essential plasma proteins. Nevertheless, over-eating, especially of proteins, and excessive toxin production subject the liver to strain, and if this is long continued its activity is handicapped and a slow degeneration of its cells occurs.

Dietary treatment plays a very important role in the management of liver disorders, but in all of them the general principles apply of excluding or restricting fats, giving adequate protein, and increasing the normal intake of carbohydrate. Details are different for the various disorders. For the purpose of arranging diets, although not for medical or surgical treatment, the pathological conditions of the liver may be considered in four groups:

(1) Acute hepatic congestion, such as occurs in bilious attacks, 'chills on the liver', hepatitis, and catarrhal, toxic, or infective jaundice.

(2) Chronic venous congestion, such as occurs in obstructive heart or lung diseases.

(3) Cirrhosis of the liver, from chronic interstitial hepatitis or alcoholism.

(4) Acute necrosis of the liver, also known as acute yellow atrophy.

It is more convenient to discuss diet in gall-bladder disturbances separately from that required in liver disorders.

ACUTE HEPATIC CONGESTION, OR HEPATOCELLULAR JAUNDICE

The most frequent causes of biliousness are over-eating, unwise selection of food or drink, and constipation. Catarrhal jaundice is associated with chills, whilst toxic and infective jaundice occur as complications of acute fevers, including influenza, after the administration of certain drugs and toxic poisons or after damage of unknown origin to the liver cells.

The dietetic treatment involves an initial period of rest to the liver by abstaining from food for a day or two, according to the severity of the symptoms, and taking only light beverages such as tea, fruit juices, and ginger ale, and sweetening these wherever possible with glucose. If nausea and vomiting are persistent the patient may be fed through a duodenal tube, or intravenous glucose in a 5 to 10 per cent solution may be required for a day or two. These forms of feeding should not be continued when nausea and vomiting have been overcome and fluids and food can be taken by mouth. Barley sugar or glucose sweets may be given to suck but all forms of alcohol are to be avoided. A vitamin B_1 concentrate should be given, until this factor can be supplied by the diet, in order that carbohydrate can be fully metabolized. Later, milk, cereals, and dry toast with Marmite may be added. A suitable arrangement of an intermediate diet before solid foods can be well tolerated is as follows:

Breakfast—Soft cereal with Bemax and skimmed milk and sugar or syrup, toast with Marmite or jelly, weak tea with skimmed milk or lemon.

Mid-morning—Juice of two oranges in water sweetened with glucose.

Lunch—Vegetable soup made with skimmed milk or with stock; or chicken broth; fruit jelly or stewed fruit; toast.

Tea—Toast with jelly, jam or Marmite; weak tea with skimmed milk or lemon.

Evening meal—Well-sweetened bread and milk—using skimmed milk.

At bedtime—Orange juice or barley water with glucose.

When a fuller diet can be resumed the general principles under-

lying the dietary management of all liver disorders should be observed; that is to say, the diet should be high in carbohydrate, adequate in protein, and low in fat. Rich, greasy, and fried foods must be avoided. No strong condiments or spices should be used in cooking. Lean tender meat is recommended, the fat being removed before serving. Simple foods must be preferred to made-up dishes. White bread, fine cereals, eggs, legumes, and potato are allowed, but coarse breads and fruits and vegetables that leave considerable residue should be excluded. Constipation must be avoided; the ample fluids that are allowed, together with fruits and vegetables, should aid bowel function. Marmite and Bemax are recommended because it is essential to ensure a good intake of vitamin B_1 when a high carbohydrate diet is given. Many people who are prone to liver congestion are overweight, and some reduction as a result of the fat restriction should prove beneficial.

DIET IN CHRONIC HEPATIC CONGESTION

The congestion of the liver is due in these cases to backward pressure in the inferior vena cava and the hepatic veins. In chronic diseases of both the heart and the lungs it is obvious that a balance must be struck between the demands of these organs and those of the liver. It is probable that a certain degree of œdema is present and there is often impaired digestion as a result of circulatory stasis in the portal system.

In constructing a suitable diet the general principles outlined in the dietary treatment of acute hepatic congestion may be followed, except for the initial period of semi-starvation; but a high carbohydrate diet is liable to cause flatulence that can be very distressing. On the other hand, proteins are well tolerated in the hepatic congestion of heart disease. Both fluids and salt must be restricted in view of the tendency to œdema. Meals should be small and dry, the fluid intake being limited to 30 ounces a day. Only the salt that is necessary in cooking is allowed, and even this should be kept at a minimum. The largest meal should be given at midday, the food should be eaten slowly and be thoroughly masticated, for this helps to avoid flatulent distension. A suitable diet for these patients might be:

Breakfast—Lightly boiled or poached egg; toast with jelly or marmalade; one cup of sweetened tea with milk.

Mid-morning—A fruit juice or milk drink—not exceeding 5 oz.

Midday—Tender meat, chicken, rabbit or white fish; potato, sieved or puréed vegetables, excluding peas, beans, onions, cabbage or broccoli; milk pudding or fruit, rusk or toast.

Tea—One cup of tea with milk and sugar and one or two rusks or biscuits.

Evening meal—White fish, tongue or lean meat; toast with a little butter, or bread and milk sweetened with glucose.

The chief reasons why glucose is recommended in place of ordinary sugar are that it does not ferment and larger quantities can be given without over-sweetening.

DIET IN CIRRHOSIS OF THE LIVER, OR CHRONIC INTERSTITIAL HEPATITIS

The cause of this condition and the stage at which it exists must guide the dietary treatment. It is still one off the commonest of the chronic hepatic conditions. It is often associated with gastritis and, unfortunately, many patients do not know of the presence of the liver degeneration until it is well advanced and symptoms of biliary obstruction appear. Cirrhosis may be portal or biliary.

Portal cirrhosis is often due to chronic alcoholism or to syphilis. Ascites and hæmorrhoids follow upon portal obstruction, and intestinal catarrh is common. There is slight enlargement of the spleen. Phthisis, pleurisy, or peritonitis may develop as complications.

Biliary cirrhosis, or Hanot's disease, affects young people between the ages of twenty and thirty and is not uncommon in young children. It may affect several young people in the same family, but it has no connection with either alcoholism or syphilis. The liver is uniformly enlarged and is sometimes adherent to the diaphragm. The spleen shows greater enlargement than with portal cirrhosis, but there is no gastro-intestinal catarrh and ascites is absent until late in the course of the disease, when it may accompany secondary portal cirrhosis.

Dietary treatment. Whatever the form of the cirrhosis the general principles of the dietary management are the same, modified only in accordance with the prominence of symptoms that affect nutrition. The chief aim is to eliminate any source of irritation to the liver and to lessen the burden upon that organ. Where the symptoms are mainly those arising from disturbance of gastric and intestinal function, the

diet for chronic gastritis is used. In severe or advanced cases, milk is probably the best food to form the basis of the dietary. It may be diluted with plain water or with soda water. It may be citrated or peptonized and it may be flavoured. Benger's food or milk jelly and other variants may help to relieve the monotony of the feeds, but from 4 to 5 pints should be taken during the twenty-four hours. Orange juice and glucose should also be given and, seeing that the liver serves as a storehouse for several of the vitamins, it is essential that in all cases of liver dysfunction a review of the diet with reference to its vitamin content should be made. If solid food can be taken, it must be remembered that moderation in eating is a necessity; rich, greasy, fried, spiced, twice-cooked, or seasoned foods should be avoided and no alcohol is permitted. The only salt allowed is that used in cooking. The foods suggested for chronic hepatic congestion are suitable. These include milk, cheese, eggs, cereals, vegetables, white bread, butter, meats including scraped beef, chicken, rabbit and liver, potatoes, tapioca, rice, sugar, honey, candy, jams, jellies, marmalade, and biscuits.

DIET IN ACUTE NECROSIS OF THE LIVER

This is a rare disease. Women are more often attacked by it than men, and it is commonest between the ages of twenty and thirty, as is biliary cirrhosis. Emotional conditions, alcoholism, syphilis, and pre-existing disease of the liver are said to be contributory causes, and poisoning by phosphorus, T.N.T., or arseno-benzol give rise to similar hepatic changes.

Attempts are made to eliminate toxins by purgation, and large doses of sodium bicarbonate are given. Carbohydrates and fluids are administered to their utmost limit—by the oral route, by duodenal feeding, and by subcutaneous or intravenous injection. As the patient shows improvement, milk, either plain or peptonized, flavoured or thickened with a cereal, is introduced cautiously; and then other foods are added slowly, choosing them with the same limitations as are observed in other hepatic diseases.

DIET IN DISEASES OF THE GALL BLADDER

The gall bladder is not an important organ as far as its function is concerned. It and its ducts may, however, become the seat of

inflammation or gallstones may develop. The usual causes of biliary tract disorders are thought to be infection and stasis. Infection may be carried by the blood from any part of the alimentary tract, including carious teeth and septic tonsils. The *Bacterium coli* and the typhoid bacillus may find their way into the biliary tract. Constipation may be one of the causes of stasis, for it is only during peristalsis that bile flows freely into the duodenum. When the passage of food is abnormally slow the bile is to a certain extent dammed back. As it stagnates it tends to become thickened and some of its cholesterol may be thrown out of solution. Other causes of bile stagnation are sedentary occupations, pregnancy, and obesity.

Many theories as to the causation of gallstones have been advanced, but, as these stones are of several different kinds and compositions, it is likely that they are formed in different ways. Mineral matter may be deposited around bacteria, forming hard, rough stones, whilst cholesterol forms softer, faceted stones. As cholesterol is a constituent not only of many living cells but also of bile, it follows that stagnation and thickening of the bile may favour the formation of cholesterol stones. Blood cholesterol is raised during pregnancy and its percentage in bile is also increased. It is not surprising, therefore, that gallstones are more common in middle-aged women who have borne children than in other people. If a stone obstructs the cystic or the common bile duct, acute biliary colic ensues, and diet must then be withheld until the attack subsides, when hot tea with lemon, hot sweetened water, barley water, cereals with skimmed milk, and toasted white bread may be given.

Inflammation of the gall bladder, or cholecystitis, may be acute or chronic, and the latter may be associated with the formation of gallstones. The dietary treatment of *acute cholecystitis* consists of giving bland fluids only and does not differ from that given in biliary colic after the attack has subsided.

In *chronic cholecystitis* the dietary treatment should aim at stimulating the flow of bile and eliminating irritants of the bile passages; peristalsis should be stimulated and constipation avoided. Thus the tendency to the formation of gallstones may be minimized. In addition, regular exercise is important, especially for middle-aged women with a tendency to obesity.

The diet should be comparatively low in fats, except for emulsified fats, such as cream, butter, and egg-yolk, for these are useful in

stimulating the flow of bile. Protein should be adequate and the necessary Calories to compensate for the low fat content may be made up by a moderate increase in carbohydrates. Some authorities hold that foods with a high cholesterol content should be avoided, but as the cholesterol in bile does not come from food other authorities maintain that the influence of diet upon bile cholesterol may be disregarded. As food intake is the normal stimulus for the flow of bile, four to six rather small meals should be taken daily. Breakfast should be an ample meal in order to utilize the bile that has been secreted during the night.

A suitable arrangement of the dietary for one day might be as follows:

Breakfast—Baked apple with milk; soft fruit or fruit juice; light cereal with skimmed milk and sugar; poached or boiled egg or white fish; dry toast and marmalade; tea or coffee with skimmed milk.

Mid-morning—Sweetened orange juice with water, and rusks or biscuits.

Lunch—Beef broth, white meat or lean red meat; baked, boiled, or mashed potatoes, green vegetables, carrot or turnip; stewed fruit or milk pudding, or cheese with rusks, or biscuits.

Tea—White bread or toast with a little butter; seedless jam or honey; sponge cake; tea with skimmed milk or lemon; sugar to taste.

Dinner—Vegetable soup made with skimmed milk; then similar to lunch, with white fish instead of meat if desired.

At bedtime—Skimmed broth with toast or rusks.

It should be remembered that skimmed milk has the same amount of protein as has full cream milk. The quantities of all the foods taken should depend upon the patient's weight. The chief foods having a high cholesterol content are, in order of percentage, egg-yolk, ox or calf brains, calf pancreas, salmon, roe, kidney, black caviare, oysters, ox liver, large shrimps, and lard. Legumes contain a moderate amount; so that if a low cholesterol diet is advised the foregoing are the foods to avoid.

Pre- and post-operative diets for patients with cholecystitis are given in the chapter on nutrition in surgical conditions.

CHAPTER 17

DIET IN DISEASES OF THE URINARY TRACT

There have been considerable modifications in the dietetic treatment of kidney diseases in recent years. Some time-honoured conventions and practices have been reconsidered in the light of fuller knowledge of both normal and impaired physiological functions, and have consequently been reviewed and restated. For example, the practice of giving a protein-free diet in cases of albuminuria is now recognized as unnecessary, for the amount of amino-acids absorbed from the small intestine has no influence upon the amount of serum albumen in the blood plasma—the source from which the urinary plasma is derived. When, however, the excretion of urea by the kidneys is defective, protein in the diet must be strictly limited, since the only channel for elimination of excess proteins that have been digested and absorbed is from the kidneys in the form of urea. Much more important than the protein intake in many kidney diseases is the administration of the optimum quantities of water and salt.

There are between two and four million nephrons in each kidney, a far greater number than the functional needs of the body demand, and at no time, under normal conditions, are they all working. In fact the work of the kidney can be satisfactorily carried out by only half the normal number of nephrons. So it follows that, unfortunately, a great many nephrons may be destroyed by disease before clinical symptoms are recognized.

There are many types of nephritis, each requiring different dietary treatment. The disease may be acute, subacute, or chronic. There may be nephrosis, nephrosclerosis, or uræmia. In addition, renal calculi may form, or there may be infective conditions, such as pyelitis, pyelonephritis, or cystitis.

The dietary treatment of all forms of renal disease, in addition to meeting ordinary nutritional needs, has the following objects:

1. To lighten the work of the impaired kidneys and so give them a chance to recuperate.

2. To avoid an accumulation of toxic waste products in the body that might give rise to uræmia.

3. To overcome the tendency of the body to retain water and sodium chloride, and the consequent development of œdema.

4. To maintain a normal acid/base equilibrium in the body.

In all kidney diseases the fluid intake and output should be carefully measured and recorded.

ACUTE NEPHRITIS

This may be either focal or diffuse. Acute focal nephritis affects children and young adults and occurs during an attack of an infective condition such as tonsillitis or mild scarlet fever. There may be albumen, blood, or casts in the urine, but there is no œdema or rise of blood-pressure. The dietary treatment is that of the causatory condition, and will be mainly fluids while the temperature remains high; followed by a light diet. It is usual to exclude meat until the urine becomes normal, which occurs when the primary infection has subsided; but, as already indicated, the reduction of dietary protein is not now considered to be desirable.

Acute diffuse nephritis also affects children and young people. It may follow the acute stage of scarlet fever, tonsillitis, and other conditions associated with the production of bacterial toxins. It may be due to irritant drugs, such as turpentine, arsenic, carbolic, or mercury, or it may occur during pregnancy as a result of endogenous toxins. The symptoms include headache, nausea, vomiting, convulsions, a temporary rise of blood-pressure, and some œdema. Urinary secretion is diminished and there is albuminuria and probably hæmaturia.

There are three schools of thought with regard to the dietary treatment of acute diffuse nephritis, but in all cases the diet must be adjusted to the needs of the individual patient and it is generally agreed that in the early stages the food and fluid intake must be reduced to a minimum.

Some physicians prescribe only one pint of sweetened orange or lemon juice for the first few days. This represents the juice of eight to ten oranges or lemons with 30 per cent glucose, the amount of

glucose required being 3 ounces. Most patients can tolerate and actually enjoy this even when nausea and vomiting are present. The Calorie value is about 1,200, but the feeds contain no protein or fat. The absence of fat is of no significance. The absence of protein means that the patient will not be in nitrogen equilibrium and will need to break up some of his body tissues. For that reason the glucose fruit-juice feeds cannot be continued as the main form of nutriment for more than a few days, and even then it is important that vitamin B concentrates should be added to two or three of them, for if carbohydrate is metabolized without aneurin intermediate products are formed which lead to gaseous distension of the intestines and cramps in the muscles, and which may intensify the nausea.

If anuria supervenes, no drinks should be given until urinary secretion can be restarted, for there is plenty of water in the œdematous tissues that can be excreted when the kidney function is restored, and the giving of fluids merely increases the œdema. As the secretion of urine is re-established the œdema subsides and the blood-pressure falls. In favourable cases this occurs within two or three days, and then the fruit-juice drinks with glucose can be steadily increased and oatmeal gruel, toast or bread, butter and marmalade may be added, but no salt may be given.

Another line of treatment during the initial stage is to give alternate feeds of 5 ounces of citrated milk and 5 ounces of glucose fruit-juice mixture every two hours from 8 a.m. till 8 p.m., with one glucose fruit-juice drink during the night.

The third dietary régime is the giving of a Karell milk diet for the first three to four days, supplemented by fruit juice and lactose to increase the Calorie intake. In its original form, first introduced in 1865, the Karell diet consisted of 7 ounces of skimmed milk four times a day. It was later modified to include six feeds of 5 ounces during the day with one feed during the night. It proves very monotonous and rather unpalatable to a patient with a tendency to nausea and its Calorie value is too low for it to be continued for longer than is considered to be really necessary.

Whatever the initial dietary treatment, the diet during the recovery stage is on much the same lines whilst the patient is still at rest in bed. The following diet might be arranged:

Breakfast—Grapefruit or orange with sugar, or 2 ounces of tomato

juice; 2 ounces of bread or toast, butter, and marmalade. Tea with milk and sugar as desired.

Mid-morning—An orange or an apple if desired.

Lunch—6 ounces of potato or green vegetable (excluding peas and beans), 2 ounces of meat or 2½ ounces of fish. Batter or milk pudding; stewed, tinned or fresh fruit.

Tea—1½ ounces of bread or toast or 1 ounce of bread and two biscuits, with butter, honey, or jam. Small cup of tea with milk and sugar.

Supper—5 ounces of fruit or vegetable salad. Bread or biscuits, butter and cheese; 4 to 5 ounces of fluid.

No other drinks may be taken during the day and no salt may be eaten with meals although a little is allowed in cooking. The amount of bread allowed is 52 ounces a day—two biscuits being substituted for ½ ounce of bread when desired. The daily ration of milk should be 15 ounces and meat should be restricted to 2 ounces. Thus the diet will contain approximately 50 grammes of protein. It should be continued until the œdema has disappeared, the blood-pressure has returned to normal, and the quantitative test for albumen (Esbach's) shows not more than half to 1 gramme per litre. Then chicken, fish, or meat may be taken either with the midday or the evening meal and by degrees the ordinary diet may be resumed. After complete recovery, no dietary restrictions are necessary. This is emphasized because of the prevailing tendency to restrict proteins for an indefinite period after an attack of acute nephritis.

SUBACUTE NEPHRITIS

This is also known as hydræmic or parenchymatous nephritis. It may follow the acute form if fatty degeneration occurs in the kidney, or it may commence insidiously. The symptoms are albuminuria and œdema, with consistently raised blood-pressure. There is no cure, so treatment is aimed at controlling the symptoms that give rise to discomfort or threaten to shorten the patient's life. As long as there is œdema, salt should be excluded and fluids limited to about one pint a day. If symptoms of uræmia appear, protein must be restricted; the diet suggested for acute diffuse nephritis being suitable. Sometimes these cases are prolonged and come to resemble nephrosis rather than subacute nephritis. The dietary treatment is then similar to that recommended for nephrosis.

NEPHROSIS

Several dictionaries compiled for the use of nurses define this term as 'any renal disease', but in most medical literature it is taken to mean a particular type of kidney involvement characterized by marked albuminuria and œdema but without hæmaturia or any rise in blood-pressure. It is associated with an increase in the fatty constituents of the blood and a lowered metabolic rate. It is sometimes called 'lipoid nephrosis', and in a few cases a marked improvement has been reported following the administration of thyroid extract.

The dietary treatment is guided by two important aims—to limit œdema by restricting fluids and salt, and to make good the loss of protein in the urine. Because of the tendency for fatty substances to accumulate in the blood, a low fat diet is advised. In nephrosis there is no nitrogen retention so there is no need to restrict protein in the diet; in fact the high albuminuria leads to such a reduction in the plasma protein that the œdema is markedly increased. A diet containing 150 to 170 grammes of protein and not more than 20 to 30 grammes of fat has been recommended. It makes little difference whether the protein is given in the form of eggs, fish, cheese, meat, or any other food, for they are all reduced to amino-acids in the alimentary tract. Indeed, some red meat is desirable for its iron content, whereas when milk forms the main source of dietary protein this important mineral is in inadequate supply. The diet for one day might be arranged as follows:

Breakfast—Fruit; cooked cereal with sugar; two eggs or 4 ounces of white fish; dry toast or bread; marmalade; 5 oz. of tea or coffee with skimmed milk.

Mid-morning—An orange, an apple, or other fruit.

Lunch—Oysters, raw, stewed or broiled; 4 ounces of lean meat or breast of chicken; potato, peas, beans, or lentils; milk pudding or fruit; not more than 3 ounces of fluid.

Tea—One small cup of tea with sugar and skimmed milk as desired; 2 ounces of white fish or lean meat, bread; 6 ounces of vegetable or fruit salad.

Supper—Chicken broth to which chopped nuts, celery, white of egg, and gelatine have been added; steamed fish; spinach, potato, fruit; biscuits and cheese; not more than 5 ounces of fluid, which could be tea or coffee with skimmed milk, taken after the meal.

Salt must not be used in cooking or added to the food when eaten, and no extra fluid may be taken either with or between meals. Nephrosis usually yields to treatment, but the dietary restrictions must be continued for a period extending for from about six weeks to six months or more. It is, however, essential that the general condition should be maintained at a satisfactory level, for patients with nephrosis show an increased tendency to develop septic infections.

NEPHROSCLEROSIS

This is a condition that seldom develops before middle age, and it may not appear until the patient is about fifty-five. It has also been called *malignant hypertension* and *chronic interstitial* nephritis. It is characterized by the passing of abundant urine of low specific gravity which may contain albumen or casts, or may be free from any abnormal constituents. Secretion goes on during the night at the same rate as by day, and the patient usually has to get up several times each night to pass urine. Blood-pressure rises and there may be marked arteriosclerosis. There is often nitrogen retention, and the accumulation of nitrogenous waste products in the blood gives rise to symptoms of uræmia—the usual cause of a fatal termination.

Little is known of the cause of this condition and there is no cure. The dietary treatment is designed to maintain the body in the best possible condition and to prolong life. The main object is to reduce the need for urinary excretion of protein waste products and to replace the water and salt that are lost as a result of the polyuria. On the other hand, it has been authoritatively stated that more damage may be done by protein starvation than by protein excess; so that, as with all kidney diseases, the treatment must be adjusted to the individual patient.

Carbohydrates should form the main part of the diet, the amount of protein allowed depending upon whether the blood urea is increased or not. With regard to the *kind* of protein that is given, it is important to recognize the fact that the four kinds—those of milk, eggs, fish, and meat—are each absorbed from the alimentary tract as amino-acids; but, in addition to protein, fish contains purine bodies and meat contains the creatinine extractives as well as purines. These substances are eventually excreted by the kidneys as uric acid and creatinine, and they should be avoided when the blood urea is

raised above 40 milligrammes per 100 cubic centimetres. Alcohol should be forbidden when the blood-pressure is high, and if the patient is overweight he should follow the dietetic régime for obesity until his weight becomes normal for his age and height. The following diet gives 310 grammes of carbohydrate, 52 grammes of protein, and 78 grammes of fat. It is suitable for a patient with nephrosclerosis when the blood urea is raised:

Breakfast—Porridge made with half an ounce of dry oatmeal; 2 ounces of bread; 1 ounce of jam or marmalade; 4 ounces of fruit, such as apple, orange, peach, or pear; 4 ounces of milk for porridge and tea.

Midday—3 ounces of chicken; 4 ounces of potatoes; green vegetables as desired; 4 ounces of fruit; 2 ounces of bread.

Tea—2 ounces of bread; 1 ounce of jam; 1 ounce of plain cake; 2 ounces of milk in tea.

Evening meal—$1\frac{1}{2}$ to 2 ounces of white fish; 4 ounces of potatoes; 2 ounces of bread; 4 ounces of fruit; 2 ounces of milk.

Also allowed during the day—$2\frac{1}{4}$ ounces of butter and $1\frac{1}{2}$ ounces of sugar. If early symptoms of uræmia appear, such as nausea, vomiting, and blurred vision in addition to raised blood urea, the diet should be restricted to water, fruit juice, and glucose. Fluids *must* be administered, and if vomiting is severe they are given by rectal or intravenous injection, normal saline with sodium bicarbonate and glucose being used, together with vitamin B_1 or aneurin.

NEPHROLITHIASIS, OR RENAL CALCULI

Calculi, or stones, that form in the kidney may be quite small, being little more than gritty particles, or they may be large enough to fill the pelvis of the kidney. Dietary habits may be a factor in their causation and so also may insufficient exercise and continued, profuse sweating. Deficiency in vitamin A is thought to predispose to their formation, and hyperparathyroidism is sometimes associated with renal calculi. If a stone attempts to pass down the ureter the patient has an attack of renal colic, which is an extremely painful condition. Eventually the stone may be passed in the urine. It should then be analysed.

Before suggesting modifications of diet it is important to know the chemical composition of the stone. It may be composed of calcium

or magnesium phosphates, carbonates, and oxalates, and, as these minerals are soluble in an acid, the urine may be found to be alkaline, either from an excessive intake of foods that are rich in alkaline substances or resulting from an infective process in the kidney. On the other hand, uric acid and cystine stones develop in an abnormally acid urine, but these stones are much less common than the former type.

It is doubtful whether any dietary modifications *can* affect the formation, but it is generally accepted that a low fluid intake or a high fluid loss from the skin may favour the formation of stones by concentrating the mineral salts that are excreted by the kidneys. Therefore, any patients who have signs of renal calculi or who are passing gravel or crystalline deposits in the urine must be given large quantities of fluid—as water, barley water, imperial drink, lemonade, or one of the natural mineral waters. At least four to five pints of fluid should be taken daily, and more if perspiration is excessive.

For the kind of calculi that form in an alkaline urine it has been suggested that a diet in which the total acid-ash exceeds the total alkaline-ash will so change the reaction of the urine that small stones *may* be dissolved or that no more may form. The characteristics of such a diet are that no salt shall be added, the foods in which acid-forming elements predominate—such as lean beef, eggs, oysters, oatmeal, whole-wheat, wheat flour, whole-grain cereals, and rice—should be generously included, and those in which base-forming elements predominate—such as olives, carrots, beetroot, turnips, parsnips, spinach, and dried fruits and vegetables—should be restricted; and that vitamin concentrates should be given, especially vitamin A. One pint of milk should be allowed daily, with the addition of cream when procurable.

When stones are formed mainly of uric acid and cystine the diet should have a high alkaline-ash content. Roughly speaking, fruits and vegetables should be taken in abundance, whilst the acid-ash foods, such as meats and cereals, should be restricted. The diet should be high in vitamin A content, and the dietary treatment may be augmented by the administration of citrate or acetate of potassium, for this renders the urine alkaline.

In all forms of nephrolithiasis water must be taken freely in order that the urine shall be diluted, for concentration of the urine favours the precipitation of stone-forming substances.

No diet can, or should, be arranged to include only acid-forming or base-forming foods; but diets can be built up to give a preponderance of one or the other. As an indication of the kind of menu that might be arranged in each case the following diets may prove helpful, an average serving of each food being taken. Seeing that coffee and tea are neutral substances they can be taken as desired. Fats and sugars are completely oxidized in the body into carbon dioxide and water, and have no effect upon the reaction of the urine. They can, therefore, be given as freely as the Calorie allowance permits.

ALKALINE-FORMING DIET

On waking—A glass of orange juice.

Breakfast—Baked apple with cream. Bread or toast, butter, and marmalade.

Mid-morning—A glass of milk or a cup of chocolate.

Lunch—Stuffed tomato or steamed fish; celery heart or spinach; cantaloupe; bread and butter.

Evening meal—Cream of carrot soup; baked potato with baked beans; lettuce, beetroot, and other salad vegetables, bread and butter; orange ice.

On such a diet the excess of base over acid is approximately equal to 100–125 cubic centimetres of normal alkali.

ACID-FORMING DIET

On waking—A cup of tea.

Breakfast—Stewed or fresh plums or oatmeal porridge; bacon and eggs; bread and butter.

Mid-morning—Cup of broth.

Lunch—Any meat, or a helping of fresh, steamed haddock; peas, asparagus, or onions; bread and butter.

Evening meal—Oysters, or meat or chicken soup; roast lamb with cranberry jelly; small helping of potato, other vegetables as at lunch; cereal pudding; bread, butter, and cheese as required.

On such a diet the excess of acid over base would be approximately equal to 45–50 cubic centimetres of normal acid.

INFECTIONS OF THE URINARY TRACT

These include pyelitis, pyelonephritis, and cystitis. The causatory organism of at least three-quarters of such infections is the *Bacterium coli*. The urine remains acid unless suppuration commences; when the urea content may decompose and produce ammonia, which alkalinizes the urine. The infection then usually extends to the bladder and cystitis supervenes. If the inflammation involves the kidney tissue and suppuration occurs, the condition is known as pyelonephritis.

In the first stage of treatment the patient is kept in bed and abundant fluids must be given, an adult taking at least eight pints in the twenty-four hours, usually combined with the administration of citrate of potassium to render the urine alkaline. Suitable fluids are water, fruit juices, and diluted milk. Glucose may be added, and as soon as the toxæmia appears to be subsiding light farinaceous foods, bread, butter, and biscuits may be added. After the acute stage has passed, the giving of a ketogenic diet (page 240) is often found to be bactericidal owing to the formation of acids in the process of oxidation of fat, particularly of B-hydroxybutyric acid which is excreted in the urine and sterilizes it. But as many of these patients complain of nausea they are unable to tolerate a high fat diet.

A low Calorie ketogenic diet may be better tolerated than the high Calorie diet that was previously recommended for these conditions. Eggs, bacon, butter, cream, salad oils, and fat meat are used to supply the necessary fats, and the carbohydrate content of the diet is kept low. The amount of protein included is the same as for an ordinary diet. It is difficult, however, to induce a patient to take even a low Calorie ketogenic diet for very long on account of the nausea it induces together with the nausea that is symptomatic of urinary infections. The present trend in dietary treatment of urinary infections is to use either the acid-ash or the alkaline-ash diet to control the reaction of the urine, according to whether it is desired that this shall be acid or alkaline; and then to prescribe a urinary antiseptic such as mandelic acid, or to employ sulphonamide or penicillin therapy.

CHAPTER 18

DIET IN OBESITY AND UNDERWEIGHT

The excessive storage of fat is only possible if the food intake is greater than the amount metabolized. This does not mean that the obese person grossly over-eats, for the causes of obesity are complex and are not yet completely understood. On the same diet and with the same expenditure of physical energy, one person will put on weight whilst another will not, even when no endocrine dysfunction can be traced. Nevertheless, the contributory causes of obesity have been classified as: (1) over-eating, (2) lack of exercise, (3) hereditary tendencies, and (4) lowered metabolism resulting from an endocrine disorder.

The disadvantages of obesity, apart from the unsightly appearance of the over-fat person, are that the physical activity is limited by the overweight itself and by the fact that muscles cushioned in fat are unable to contract readily; the nutrition of the skin and the removal of waste products from it are hampered when the circulation is blocked by excessive fat between it and the main blood-vessels; the person easily becomes overheated owing to the insulating layers of fat that prevent the normal loss of heat from the skin; the accumulation of fat in the region of the diaphragm interferes with its free movement in respiration, and the presence of excessive fat around the heart lessens its ability to meet the additional demands made upon it. It is generally conceded that obesity decreases the expectancy of life.

Most people who are overweight claim that they have small appetites, but on investigation it may appear that, although the bulk of the diet may not be excessive, its Calorie value may be unduly high, for the food is probably in concentrated form and a considerable amount of fat and sugar is used in its preparation. Cakes, sweets, or nourishing drinks may be taken freely between meals. The diet is low in roughage and the patient therefore tends to be constipated. Sometimes it is found that the patient over-eats from sheer

boredom, or as an outlet for worry, anxiety, and nervousness; but obesity from this cause is much less common in Europe to-day than it was in the years preceding the late war. The success or failure of dietary treatment depends upon the degree to which the patient will co-operate. The diet should satisfy and at the same time limit the appetite; so that spices, condiments, and extractives should be avoided and alcoholic stimulants to gastric digestion should not be taken before meals. On the other hand, if the patient wishes to smoke before a meal this might be allowed because it lessens appetite. The Calorie value of the diet should commence at 70 per cent of an ordinary diet and be gradually reduced to 50 per cent, so that the patient must inevitably draw upon his reserves of fat to supply his metabolic needs. It is occasionally an advantage to give only skimmed milk and orange juice for one day a week. A reduction of 1½ to 2 pounds a week should not, as a rule, be exceeded.

In constructing the diet it must be seen that the protein is adequate, but not excessive, for it is needed for tissue repair. It can be supplied by lean meat, white fish, eggs, and cheese. The remainder of the Calories should be supplied chiefly by carbohydrates, for if these are too greatly restricted ketosis might develop, with its accompanying symptoms of headache, muscular weakness, and exhaustion. Fats must be reduced to a minimum, allowing only those that supply vitamins A and D, such as butter, cream, egg-yolk, and liver. All the necessary mineral salts and vitamins must be present in sufficient quantities to regulate and protect the body from various abnormal conditions that may follow when any of these is deficient. Salt is usually restricted. Many of the 'fad' diets recommended for reducing weight ignore some of the fundamental principles underlying normal nutrition and the cause of obesity in the particular person. For this reason, dietary treatment should be preceded by a thorough physical examination to exclude endocrine disorders and heart or kidney disease. The patient's personal habits regarding not only the food and drink he takes but also the amount and kind of laxatives and other medicines, the degree of exercise he takes and the amount of sleep he obtains must be taken into account. The prescribed diet should then be written out for the individual patient, taking into consideration his circumstances and the kind of life he must lead.

The foods usually allowed are: eggs in any form except fried or otherwise prepared with fat; cheese made of skimmed milk; lean

beef, mutton or lamb, chicken, rabbit or turkey, roasted or grilled, but excluding fat poultry like goose and duck; steamed white fish; clear broths and strained soups; all kinds of fruits and vegetables except that potatoes should be limited; a limited amount of cereals and one thin slice of bread or toast at a meal. Beverages such as skimmed milk are allowed, and so also are tea and coffee, but meals should be taken rather dry.

Foods to be avoided or used very sparingly are: all fried foods and pastries, meat fat, salad dressings, nuts, cream, sugar, jams, honey, sweets and sweetened fruits, and desserts. Starchy foods like potatoes and cereals should be taken only once or twice a week. Milk should be limited to half a pint of skimmed milk a day for all purposes, including cooking, and butter or margarine to half an ounce daily.

Among the special diets recommended for obesity are:

Banting diet. This gives approximately 1,100 Calories, which are supplied by 172 grammes of protein, 81 grammes of carbohydrate, and 8 grammes of fat.

Von Noorden diet. This gives from 1,160 to 1,600 Calories, and it contains 120 to 180 grammes of protein, 100 to 120 grammes of carbohydrate, and 28 to 40 grammes of fat.

Ebstein diet. This gives from 1,180 to 1,850 Calories, supplied by 102 to 105 grammes of protein, 50 to 120 grammes of carbohydrate, and 60 to 100 grammes of fat.

William Banting compiled the diet that bears his name as long ago as 1863. He was at that time so extremely fat that he was unable to tie his shoe-strings and had to go downstairs backwards, according to his own account; but he lost 40 pounds in as many weeks on his own diet. As originally compiled it contained much more fat and considerably less protein than is included in its present-day modification.

In arranging any diet it should be remembered that green vegetables, lettuce, watercress, asparagus, tomatoes, cucumber, melon, and pineapple have a negligible Calorie value, so that they can be taken as desired, and they are very valuable sources of mineral salts and some of the vitamins, especially vitamin C.

With regard to beverages, plain water and saline mineral and table waters are suitable, but sweetened effervescing waters must be excluded. Tea and coffee are allowed if they are taken with very little milk, and so is cocoa, for its food value is very low although it

has the advantage of being more satisfying to a hungry person than tea or mineral water. Chocolate is absolutely forbidden, for it has a high Calorie value.

Exercise as a means of weight reduction. If a diet is followed faithfully it should bring about not only a reduction in weight but also an increase in health and an enjoyment of physical activity. In addition to the restricted intake of food, attention must be given to the amount of exercise taken, for exercise increases fat oxidation. Walking is an excellent form of exercise for the obese, for it is estimated that a walk of three miles will consume about 350 Calories —about one-third of the dietary intake. Gardening, riding, golf, and tennis involve continued exercise over a comparatively long period; but although daily gymnastic exercises or a massage treatment are to be recommended for toning up muscles they are too brief to accomplish much in weight reduction. The one disadvantage of exercise is that it tends to make people hungry, and if the appetite is appeased by consuming a little more food than is allowed by the diet the beneficial effect of the exercise in weight reduction is nullified.

The type and amount of exercise must be guided by the age and the specific condition of the person, other than obesity; for so often the obese person has backache, flat feet, dyspnœa, hypertension, or cardiac embarrassment, and these disabilities limit the degree of exercise that can be taken. In such cases one must concentrate upon reducing the dietary intake. Massage may be a great help when exercise is limited, especially in cardiovascular disease. It helps to keep the tissues firm and to prevent sagging when the overlying fat layers are reduced.

The use of drugs in obesity. It is much easier for the person who is overweight to take some of the small tablets or common laxative salts that are marketed under a variety of trade names than to regulate his diet and increase his exercise. These substances have a large sale but they are not without their dangers. Most of the tablets sold contain thyroid extract, and this may increase metabolic activity to a harmful degree and lead to a condition resembling neurasthenia. Thyroid increases appetite, so that if it is used without dietary restrictions it is unlikely to accomplish the desired end.

A drug called dinitrophenol was introduced into reducing preparations some years ago. This drug increased metabolic rate and caused a

loss of weight, but it was cumulative in its action and caused vague symptoms in some people whilst in others there were changes in the crystalline lens that led to cataract formation. It is not now sold by reliable druggists but it may still be obtained in preparations that are sold through advertisement but are unobtainable in the open market.

A third drug that has been used for weight reduction is benzedrine sulphate (amphetamine). There are, however, many contra-indications for its use and it is only in selected cases that it is prescribed, and then in conjunction with a dietary régime.

Laxative salts or laxative drugs sold as 'harmless remedies' or incorporated in 'reducing foods' accomplish their weight reduction by a loss of water, not of fat, and the weight will be regained as soon as their intake is stopped and more water is consumed.

Obesity in children and adolescents. This is nearly always due to an endocrine disorder, frequently of the thyroid or the pituitary. In these cases the medical treatment is of paramount importance, the dietary management being a secondary consideration. Extracts of the glands concerned will be prescribed and frequently a combination of thyroid, pituitary, and ovarian or testicular extracts given, the patient remaining under medical care and being closely watched for increased pulse rate, excitability, and other symptoms of toxicosis. In a small percentage of cases of obesity in children the cause may be psychosomatic. It has been found that unhappy children who have little emotional security in their home life often tend to overeat as a substitute for the lack of love and emotional satisfaction; so that the existence of a possible psychogenic factor should not be ignored.

SUGGESTED DIET FOR OBESITY (1,000 CALORIES)

On waking—Glass of water—hot or cold as desired.

Breakfast—Fruit—half a grapefruit, 1 banana, 1 orange or medium-sized pear or peach; 2 thin slices of toast or 2 Ryvita or Vitawheat biscuit; coffee or tea with skimmed milk.

Lunch—Clear, fat-free soup; 1 egg served in any way but fried; shredded raw cabbage or lettuce; 1 glass of skimmed milk.

Evening meal—3 ounces of lean meat or steamed fish; average serving of low Calorie vegetables; 1 small potato; fruit; 1 slice of thin toast or 2 Ryvita.

If desired, lunch and evening meal menus may be interchanged.

If 1,200 Calories are allowed an additional glass of skimmed milk, $\frac{1}{2}$ oz. of butter, and a little more fruit may be taken.

If 1,400 Calories are allowed, add half an ounce of marmalade for breakfast and give a cup of tea with 1 buttered Ryvita at 4 p.m.

In order to vary the diet the following exchanges may be made:

Egg = 75 Calories, exchange for 1 ounce of lean meat, three-quarters of an ounce of Cheddar cheese, or milk pudding made with half an ounce of cereal and 5 ounces of skimmed milk.

Bread—1 slice half an inch thick, exchange for 3 ounces of potato or cooked oatmeal, or 3 tablespoonfuls of cornflakes or puffed wheat.

As the desired loss of weight occurs and additional Calories are allowed, the patient might be given a list of the amounts of suitable foods that yield 50 Calories (see page 80 *et seq.*), and be instructed to choose the extra Calorie allowance for himself.

Cress, cucumber, celery, and shredded cabbage or lettuce have a negligible Calorie value, so that they may be taken in addition to the foods on the menu if hunger causes discomfort.

DIET IN UNDERWEIGHT

Like overweight, leanness may be an hereditary tendency, it may be due to faulty nutrition, or to a pathological process within the body that requires medical investigation. Among the predisposing causes are tuberculosis, hyperthyroidism, Addison's disease (of the suprarenal glands), diabetes mellitis, intestinal worms or some chronic septic focus such as carious teeth or septic tonsils. Underweight is sometimes a psychological problem, manifested in a condition known as *anorexia nervosa*, or hysterical anorexia, in which there is a wilful and intentional reduction of food intake until, after a time, all desire for food is lost. Alcoholism and malignant disease result in loss of weight, and in addition to all these causes there is the condition of underweight that follows any exhausting illness. All these possible causes need to be investigated and a diagnosis arrived at before a dietary régime is arranged. Naturally, the treatment of the underlying pathological condition rests with the physician and does not come within the scope of this book.

Whatever the cause of the underweight, the objects of the diet will be to repair wasted tissues and to ensure that there is a surplus of

intake over output. Rest is therefore important in order to diminish the utilization of food in the expenditure of energy.

The patient's usual diet must be investigated and any deficiency in total Calories or in the intake of any essential food constituents must be estimated, especially with regard to proteins, mineral salts, and vitamins. Then a diet must be arranged that will supply not only the normal needs but 300 to 500 Calories in excess of this. The excess should be in carbohydrates and easily digested fats unless marked muscle wasting is present, when additional protein must be given. Greasy foods are distasteful to the majority of people but they are especially so to underweight patients. Fats in an emulsified form, such as cream and egg-yolk, are much better tolerated.

It is essential that the diet of an underweight person should be as varied as possible, for monotony has a bad effect upon appetite. A slow rate of gain is often more advantageous in building up strength than a more rapid increase, and the digestive disturbances that follow upon forcing too much food are avoided.

With judicious management 1,000 Calories may be added to the diet by the use of cream, butter, eggs, jam, honey, sweets, and ice cream, and by giving nourishment between the main meals in the form of Horlick's malted milk or Ovaltine made with milk, eggnog, glucose fruit-juice drink, or ginger ale with ice cream. The last two are specially useful as they tend to stimulate rather than to blunt appetite for the next meal.

Over-exercise should be avoided, but in moderation exercise stimulates appetite, and after an enjoyable walk an attractively prepared meal will probably be eaten in its entirety with enjoyment. Some physicians advocate the administration of carefully regulated doses of insulin to patients who are underweight, for insulin increases appetite and therefore the intake of food is likely to be more satisfactory; and where the underweight is due to hyperthyroidism a drug —thiouracil—may be prescribed in order to inhibit thyroid secretion.

Underweight patients are often rather anæmic, so that iron-containing foods, such as spinach, lean beef, liver, pheasant, and mustard and cress, should be adequately included.

The success of dietary treatment, both for obesity and underweight, can only be correctly estimated if weight charts are kept, the patient being weighed once a week and the diet modified according to the degree of loss or of gain.

SUGGESTED DIET FOR UNDERWEIGHT PATIENTS

On waking—A glass of full cream milk or fruit juice with glucose.

Breakfast—Fruit or whole-grain cereal with sugar and cream; scrambled egg, herring or bloater; bread; butter; marmalade. Coffee with milk or cream.

Mid-morning—Eggnog, or glucose fruit juice, or chocolate made with milk.

Lunch—Cream of vegetable soup; meat, fish, eggs or macaroni cheese; cooked vegetables mashed with butter; vegetable or cheese salad with mayonnaise; stewed fruit with cream; glass of milk, or coffee with milk.

Tea—Bread and butter, with jam, and cream if available; cake if desired. Tea with milk and sugar.

Evening meal—As lunch.

At bedtime—As at mid-morning.

All drinks given should have Calorie value; plain water and mineral waters being used as little as possible.

CHAPTER 19

DIET IN RHEUMATISM, ARTHRITIS, AND GOUT

The term 'rheumatism' is commonly used to denote almost any painful condition of joints or muscles. These conditions can, however, be classified into two main groups: those due to known or specific causes, such as tuberculous, gonococcal, or syphilitic arthritis; and those that are not yet fully understood, such as primary rheumatic fever, osteo-arthritis, and rheumatic arthritis. It is with the latter group that this chapter is mainly concerned, for the amount of disability that results from the included conditions constitutes a serious social and medical problem, and it has been estimated that approximately ten times as many people are afflicted with chronic rheumatic conditions, including arthritis and gout, than with tuberculosis or diabetes. Just how far dietetic measures can help in the prevention or relief of these conditions—with the exception of gout—is still undetermined; but there are few other groups of diseases for which so many special diets have been recommended, some of which have been grossly unbalanced in relation to general nutritional needs. Much of the dietetic treatment in the past has been empirical and has been indiscriminately applied to all types of chronic rheumatism and arthritis; whereas it is now realized that it is mainly in gout that specific dietetic control is of importance.

DIET IN ACUTE RHEUMATISM

This disease is believed to be due to a hæmolytic streptococcal infection, but investigations have shown that a poor diet predisposes an individual to an attack. The lack of no single essential food factor has been definitely incriminated, although it has been found that deficiencies in calcium, proteins, and vitamins A and C are common in the diets of rheumatic subjects. Indeed, it has been stated that acute rheumatism in young children is frequently a manifestation of scurvy.

Rheumatic fever is essentially a disease of the young and its incidence is much higher among poorly fed children and young people than in those whose diet is more generally satisfactory. The exceptional rarity of this disease among the boys at Eton and also in children in well-conducted residential schools and orphanages, and even in colonies for mentally defective children, has been noted. The only common factor in these communities appears to be that of a better dietary than is obtainable by the average child of families in the lower income groups; but the incidence of the disease has been lower since 1940, presumably owing to the national efforts that have been made to provide children with an adequate diet.

The usual course of rheumatic fever includes a period of acute infection in which there is a migratory inflammation of joints, high temperature, and profuse sweating, with a tendency to cardiac involvement. During this period the patient needs absolute rest in bed. The diet that is given is that for any acute febrile condition—milk, fresh fruit drinks sweetened with glucose, fruit jellies, chicken broth, thin gruel, etc.

The acute stage may be followed by anæmia, loss of weight, and pathological changes in the heart, especially related to the valves. Here again the diet should be adjusted to meet the special needs arising from these complications; but it is suggested that ample supplies of vitamin C must be given in the form of orange juice, tomato juice, blackcurrant purée, rose-hip syrup, or as tablets of ascorbic acid; for, in common with all other pyrexial conditions, the needs of the body for this vitamin are increased in rheumatic fever. It has, indeed, been suggested that this disease may be the result of the combined effect of vitamin C deficiency and infection; although the administration of twice the normal requirements of ascorbic acid has not been shown to be in any way curative.

The specific drug given in acute rheumatism is sodium salicylate; and this may give rise to gastric irritation, which can usually be lessened by giving 15 grains of sodium bicarbonate in about half a tumbler of water shortly before the medicine is due.

ARTHRITIS

There are two chief types of chronic arthritis—hypertropic or degenerative arthritis, which is often called osteo-arthritis; and atropic

or rheumatoid arthritis. These occur in different age groups and many of their features are dissimilar.

OSTEO-ARTHRITIS

This seldom occurs before forty years of age and often much later in life. It is the arthritis of people who are physiologically old, and it is thought to result from wear and tear of the joints together with repeated small injuries. For example, stone masons commonly develop osteo-arthritis of the wrist, elbow, or shoulder, whilst in agricultural labourers the hip and the spine are more frequently affected. Contributory factors are over-fatigue and exposure to cold or dampness. The patient is often overweight and has a bad posture which throws undue strain upon particular joints. Constipation and arteriosclerosis are frequently present.

It has not been conclusively shown that any special diet is of benefit in this form of arthritis; but because overweight puts a heavy strain upon joints, especially those of the lower extremities, an obese person with osteo-arthritis is often given a reducing diet. In some spas and other centres where osteo-arthritic patients are treated, the dietary régime for all patients who are overweight commences with a few days on sweetened orange juice only, combined with mild laxatives. The affected joints do not tend to become ankylosed, as with rheumatoid arthritis, so that no purpose is served by emphasizing the necessity for daily movement of the joints. In fact these patients often benefit from a few days complete rest, followed by the use of crêpe bandages or other protective appliances to the affected joints. After the weight has been reduced to normal a diet is arranged that will meet all nutritional requirements, for it must be followed for months or even years. It can be very varied, for there are no foods that are specially contra-indicated in osteo-arthritis; but it must be adequate in mineral salts, in proteins, and in vitamins, especially vitamins A and B, for these help to correct the atonic constipation that is often present.

It has recently been suggested that an adequate intake of the sulphur-containing amino-acids is important in degenerative arthritis, the opinion being based upon the low cystine content of the finger-nails and hair in 65 per cent of the patients examined. These amino-acids are cystine and methionine, the chief dietary sources of which

are eggs, casein, hæmoglobin, wheat products, and the muscle protein of sardines and fresh cod fish.

A low Calorie diet suggested for an overweight person with osteoarthritis might be arranged as follows:

Breakfast—Stewed prunes. Bran flakes with milk and sugar. One egg. Whole-wheat bread with butter. Tea or coffee.

Midday—Clear broth. Shrimp or sardine salad with lettuce, celery, and mineral oil mayonnaise. Spinach with one egg, sliced or poached. Whole-wheat bread, butter. A glass of milk or orange juice.

Evening meal—Broiled liver with onions. Green vegetable. Tomato and lettuce salad. Whole-wheat bread, butter. Some fresh fruit. Tea or coffee.

Chicken, lamb chop, or fresh fish could be given instead of liver and eggs in order to vary the menu. If it is not necessary to reduce weight the diet can be more liberal, potatoes being introduced in moderation; but it is wise to allow only three meals a day, with a nourishing drink at bedtime if desired.

RHEUMATOID ARTHRITIS

This is a disease that usually commences in young adult life. Its cause is unknown, but chronic infection is thought to be a contributory factor. Women are more susceptible than men. The pathological changes in the joints eventually lead to complete ankylosis, but the deformities and disabilities are mainly related to changes in tendons, fibrous tissues, muscular tissues, and the nervous system. A particular type of rheumatoid arthritis, known as Strümpell-Marie disease, affects the spine only and occurs principally in young men. Rheumatoid arthritis in children is often associated with enlargement of the lymph nodes and spleen. This type is called Still's disease. Many patients with rheumatoid arthritis suffer from intestinal dysfunction shown by furred tongue and atonic constipation. Peripheral circulation is often diminished, resulting in a cold, clammy skin, especially of the hands. The erythrocyte sedimentation rate is abnormally high, the hæmoglobin level is lowered, and some degree of anæmia is usually present.

GENERAL AND NUTRITIONAL TREATMENT

In treating all types of rheumatoid arthritis the same principles are followed. Many dietary régimes have been suggested. One of the oldest of these emphasizes the avoidance of acid foods, for the conditions were thought to be due to, or aggravated by, the retention of acids in the tissues. It is now much more widely realized than hitherto that the so-called acid fruits and vegetables contain weak organic acids that are formed into alkaline carbonates in the body as a result of oxidation. In any case, the body possesses a finely adjusted mechanism that is capable, under ordinary circumstances, of regulating the reaction of body fluids with an unvarying accuracy; so that with any reasonable diet there is no need to be apprehensive regarding the maintenance of the acid/base equilibrium. Moreover, the exclusion of acid fruits and vegetables deprives the patient of valuable sources of vitamins and minerals, both of which are much needed.

Other diets urge the importance of limiting the intake of proteins, especially of red meat and of foods that contain purines. Such restrictions, except in gout, have not been shown to bring about any improvement in the joint condition, but they may impair the patient's vigour and result in a persistence of the anæmia that is so often present. Some people, however, are allergic to given foods and, seeing that the anaphylaxis that follows an allergy may be associated with acute swelling of joints, any article of food to which the patient has demonstrated a hypersensitivity should be excluded from the diet; but this should be done whatever the patient's condition or disease.

Many arthritic patients have a low-grade œdema, especially in the region of the joints. Some of the pain and stiffness of the joints is thought to be due to this 'tissue œdema', and great relief may follow elimination of excess fluid. This may be achieved by varying the proportions of the foodstuffs in the dietary, for they contribute to the retention of water in differing degrees. The storage of each gramme of carbohydrate is said to demand the retention of 3 to 4 grammes of water, whilst in the storage of 1 gramme of fat only 0·1 gramme of water is retained. Protein does not cause retention of water for it is rarely stored in the body except when a deficiency has to be made up, and, furthermore, the end products of protein metabolism —urea and uric acid—require water for their excretion. It would appear, therefore, that additional protein may correct tissue œdema

and that this may be helped by reducing the carbohydrate intake. Rest in the recumbent position also promotes the passage of fluid from the tissues into the lymphatics and thence into vascular channels. This may explain why arthritic patients who are usually up and about and are suddenly confined to bed for a short time with some intercurrent illness sometimes experience a surprising improvement in the joint conditions. Contributory means of promoting the elimination of tissue fluid are a low salt intake and massage.

The conclusions that may be reached from the above discussion are that no special diet is applicable to all cases of arthritis, many patients improve on a diet that is relatively high in protein and fat but rather low in carbohydrate; but that all the factors in the condition of the patient should be taken into consideration when prescribing a diet. The medical and nursing treatment must be adequate for the control of pain, for otherwise appetite will be destroyed. Rest, radiant heat, ultra-violet light, massage, and drugs, all have a part in the general treatment. The diet should be written out for the individual patient and not be given to him on a printed slip, for he gains confidence when he feels that a genuine interest is being taken in his welfare; and it should be designed to correct faults in his dietary habits as well as to ensure adequate nutrition. Each meal should be rather small, intermediate feeds being given as required, and the patient should be encouraged to eat liberal amounts of fatty foods. These patients are often thin, and if underweight they should be given a diet that is above the ordinary maintenance level. Plenty of fresh fruit should be included and vegetables such as lettuce, tomatoes, spinach, celery, and legumes may be taken in abundance. These are good sources of minerals and of vitamin C. Cod or halibut liver oil and one of the vitamin B concentrates are also frequently prescribed, and to ensure a good supply of calcium two glasses of milk should be taken daily.

A raw fruit and vegetable diet is often advocated for arthritic patients, the green vegetables and roots being finely shredded or passed through a special mincing machine. Apple may be pulped, when the addition of a little lemon juice will improve its palatability and prevent its discoloration. Dried fruits, such as prunes, apricots, figs, and raisins, are soaked and may then be served whole or may be pulped and served with a little whipped cream. Nuts can be chopped or finely ground and sprinkled over the fruit or vegetables.

GOUT

Gout may produce a condition of permanent deformity and crippling of joints that resembles arthritis, but its cause and treatment are quite different. It is recognized as a metabolic disturbance which leads to, or is associated with, an increase in the uric acid content of the blood and the deposition of sodium biurate in the tissues, particularly in the cartilaginous tissues of joints. It is much more frequent in men than in women. It seldom occurs before middle age and there is often a family history of gout, so that it is probable that the error of metabolism is inherited. The condition may be present either in an acute or chronic form.

The joint most commonly affected is the metatarsal joint of the big toe, but any joint of the foot, or even the knee, hip, wrist, or elbow, may be involved. A characteristic attack of acute gout often commences with a slight sense of fatigue and satiety and a few twinges of pain. After a few hours' sleep the patient is awakened by extreme pain. The affected joint is hot, red, and swollen; movement is limited and no position gives any relief. Chronic or subacute gout may be characterized by headache, vague stiffness and pain in tendons and muscular tissues, and by lethargy and nervous irritability.

SOURCES OF PURINES

Uric acid is a purine body derived from nucleoproteins, or cell nuclei. These may arise from the breaking down of body tissues—endogenous purines—or they may be obtained from animal or plant foods—exogenous purines. The quantity of endogenous purines produced is believed to be more or less fixed and is not influenced by diet or drugs; but the restriction of foods containing a large amount of nucleoproteins and other purine substances undoubtedly lessens the formation of exogenous uric acid. Many cases of gout benefit by taking a purine-free diet but the severity of the attacks is sometimes quite unaffected by this form of treatment. An acute attack may follow the over-eating of foods that do not contain purines, particularly of a diet rich in fat, and by over-indulgence in alcohol. Wines and beer appear to precipitate an attack more frequently than distilled beverages. Sufferers from gout are commonly overweight and are robust in appearance.

Fatigue, brought about by strenuous exercise in a person who usually lives a sedentary life, may be an exciting cause of an attack, probably from the production of endopurines from the wear and tear of muscle cells. It is believed that the liver, and perhaps other organs, can store the precursors of uric acid for a considerable time and release them later—probably as a response to the stimulation of exercise, alcoholic indulgence, or over-eating of rich foods, even when they do not contain purines. When all these factors are taken into consideration it will be seen that although dietary control may give great relief in some cases, in others it will have little or no effect; but it is always worth trying.

DIETARY CONTROL OF GOUT

If a patient is overweight he may benefit from a low Calorie diet until his weight is reduced to normal; in fact, some authorities suggest that the optimum weight for a gouty person is 10 to 15 per cent below the calculated normal for his height and age.

With regard to the composition of the diet, it is obvious that it should be as free from purines as possible, that it should be rather low in fat but high in carbohydrate, but it must contain adequate minerals and vitamins. Rich, highly seasoned foods should be avoided, and if the patient persists in taking some alcohol he should be advised to take well-diluted whisky rather than beer or wines.

Both animal and vegetable foods contain purines. In some the quantity is practically negligible, whilst in others it is very high. The patient with gout must be given a list of forbidden foods and also of those that are recommended and those that are allowed in limited quantity. In the following list of foods containing purines the order given is in accordance with the amount present. Sweetbreads head the list with at least twice as much as anchovies. Herrings contain about half as much as anchovies, lentils about the same quantity as trout, and spinach about half as much as lentils—with meats and shellfish coming between.

High Purine Content	*Low Purine Content*	*No Purines*
Sweetbreads	Potatoes	Bread
Anchovies	Cabbage	Eggs
Sardines	Lettuce	Milk
Liver	Celery	Cheese
Kidney	Runner beans	Cereals
Herrings	Radishes	All fruits
Trout		Tomatoes
Lentils		Carrots
Pork		Cucumber
Veal		Onions
Beef		Nuts
Goose		Caviare
Chicken		
Oysters		
Mutton		
Lobsters		
Crab		
Spinach		
Mushrooms		
Peas		
Beans		
Asparagus		
Cauliflower		

CHAPTER 20

DIET IN CARDIOVASCULAR DISEASE

Diseases of the heart fall into three main groups—acute, subacute, and chronic. Both acute and subacute heart diseases are practically always the result of infection, and in particular they often accompany rheumatic fever or occur as a complication of diphtheria; and they often lead to chronic forms of heart disease.

DIET IN ACUTE HEART DISEASES

These diseases are of short duration and their dietetic treatment is on the same lines as for all acute infections. The chief object is to provide adequate nourishment without overtaxing either the digestive system or the circulation. Frequent small feeds are required, consisting of milk, thickened soups, cereals with cream and sugar, and lightly boiled or beaten-up eggs. Fruit and tomato juices are given in addition to the regular feeds, for it has been established that in all acute infections the need for vitamin C is greater than in health or in chronic infections. A limitation of the Calorie value is desirable, for when a patient is at complete rest in bed his needs are less than when he is ambulatory.

DIET IN SUBACUTE HEART DISEASES

A more liberal diet is allowed than when acute cardiac conditions are present; but it must be light and easily digested. The 'continuation diet' suggested after febrile conditions have subsided (see p. 128) is quite suitable, for no special restrictions are indicated. Such dishes as fish, chicken, game, tender meat, and cheese soufflés may be included; but the balance between diet and exercise must be regulated according to the condition of the individual patient.

DIET IN CHRONIC HEART DISEASES

These conditions may be myocardial, pericardial, or valvular. Their treatment—medical and dietary—depends more upon the degree of compensation than upon the actual extent of the lesions, for the myocardium possesses the power to increase in size and strength in order to compensate for a structural defect—such as stenosis of the mitral orifice or the inadequacy of a valve completely to close the orifice it guards. So that it is only when compensation fails that symptoms of congestive heart failure develop. Deficient oxygenation of the myocardium is thought to be one of the chief factors in bringing about congestive heart failure, for the number of capillaries remains unchanged in spite of the increase in thickness of the muscle fibres or in the whole muscle mass. The inadequate contractions of the myocardium, added to the valvular defect, bring about a circulatory stasis in the portal system and, moreover, eventually leads to inadequate oxygenation of all tissues.

In both moderate and severe congestive heart failure the patient may suffer from anorexia and nausea, and also from abdominal distension and constipation resulting from the loss of gastro-intestinal tone due to anoxæmia of the muscular and mucous structures involved. The abdominal distension is gaseous in origin and may cause an upward displacement of the diaphragm which adds to the circulatory embarrassment. Not infrequently vomiting is also present, the patient is overweight, and he may have a generalized œdema. All these factors render the problem of arranging a satisfactory diet one that is fraught with difficulties. Each case must be specially considered. If the degree of compensation is slight, the general dietary principles are to avoid bulky meals and all easily fermentable articles of diet that may cause gaseous distension. These include cabbage, onions, brussels sprouts, dried peas and beans, and concentrated sweets. Tea, coffee, and alcohol should be restricted. Over-eating must be avoided in all cases, for an increase in weight places an extra tax upon the heart and blood-vessels; but the importance of an adequate supply of glucose or dextrose can hardly be over-estimated, for it provides the fuel necessary for the muscular action of the heart. All food should be eaten slowly and be thoroughly masticated in order to limit the tendency to flatulent dyspepsia. Three small meals with two intermediate feeds, consisting of a glass of milk, are usually found to be a

satisfactory arrangement of the diet. In particular, the evening meal should be light.

Most physicians agree that a fairly low Calorie diet is an advantage in chronic heart disease, provided that it supplies mineral salts and vitamins in the correct quantities; for if patients can become, and remain, slightly underweight the work of the hypertrophied cardiac muscle is facilitated and it becomes less fatigued. Again, respiration is easier and the vital capacity of the lungs is increased. This means better oxygenation of the blood and, consequently, an improved functioning of all tissues. If no œdema is present, fluids can be given freely and there is no need to restrict salt; but aerated drinks should be avoided.

DIET IN SEVERE CONGESTIVE HEART FAILURE

The patient is nursed at complete rest in bed but in the Fowler position.

The general principles that guide the arrangement of the diet are the same as for moderate decompensation, but they are more rigid. Owing to the tendency to œdema, fluids must be restricted and the sodium chloride intake must be reduced to a minimum. If generalized œdema is present the *Karell diet* may be prescribed. This was first introduced in 1865 and in its original form consists of 800 cubic centimetres of milk daily, given in four feeds of 200 cubic centimetres (about 7 ounces or 1 tumblerful). Strictly speaking, this should be skimmed milk, but such severe limitation of Calorie value is seldom imposed. It may be considered better to give the drinks at more frequent intervals but to give less at a time. For patients who dislike milk, potato soup or rice gruel prepared without salt may be substituted, no other food being allowed. Usually, a marked diuresis occurs with consequent improvement in the cardiac condition; but as this dietary is inadequate for ordinary needs it should not be continued for more than a few days, the feeds then being increased to 1,000 cubic centimetres (35 ounces), given in six feeds of 150 cubic centimetres during the day with one during the night. Two of these feeds should be of orange, tomato, or lemon juice, with 15 grammes of sugar added to each, and the same amount of sugar or lactose may be added to the milk feeds, these being flavoured with coffee, cocoa, Ovaltine, or other suitable substance that the patient

prefers. In addition, toast, soft-boiled eggs, unsalted butter, cereals with a little sugar and cream, and some fruit are given. Potassium chloride or celery salt may be used instead of sodium chloride in order to render the unsweetened foods more palatable. Patients with recurring œdema often benefit from a repetition of the Karell diet for one day in every three or four.

MANAGEMENT OF ANOREXIA, NAUSEA, AND VOMITING

Patients with congestive heart failure seldom find the dietary restrictions too severe, for loss of appetite is a feature of their condition; but when the œdema is reduced and it is necessary to increase the dietary intake the anorexia may constitute a serious problem, especially when it is accompanied by nausea and vomiting. Although these symptoms may be due to venous stasis it must be remembered that the drug usually ordered in congestive heart failure is digitalis and that nausea and vomiting may indicate overdosage. This point needs investigating before proceeding to treat the symptoms in any other way than by withholding the drug. When not due to overdosage with digitalis, the anorexia and nausea may be overcome by a more tempting arrangement of the diet and by giving small drinks of peppermint water or other carminative, for gaseous distension will always aggravate anorexia. Sometimes solid food can be taken more easily than fluids.

If vomiting is severe absolute rest of the stomach for twenty-four hours may help to check it, giving only sips of cold ginger ale or iced champagne, if this is available and there is no gaseous abdominal distension present. After twenty-four hours, toast, milk and lime water, peptonized milk, whey, albumen water, and sieved vegetables may be tolerated; and a mixture containing bismuth subcarbonate may be ordered. If the vomiting persists, rectal feeding or intravenous administration of glucose solution may be necessary. A 5 per cent solution of glucose in distilled water is isotonic with blood-plasma, and to this may be added a vitamin B concentrate. Normal saline solution may be contra-indicated because of the presence of œdema. There is, however, another cause of œdema in patients with congestive heart failure that must not be forgotten. It may be nutritional in origin, due to insufficient intake or assimilation of proteins—a condition called *hypoproteinæmia*. In these cases, plasma transfusions are of

value when adequate protein cannot be taken by mouth. In critical cases a solution containing 5 per cent glucose and 5 per cent hydrolysed protein may be given intravenously. This has a higher protein content than plasma and, since all the patient's tissues are deficient in protein nutriment, its administration is often attended by favourable results. Concentrates of vitamin B are also necessary and ascorbic acid tablets should be taken by mouth if possible, for this vitamin is not usually added to intravenous injections because it may become oxidized before it is available to the patient.

CONGESTIVE HEART FAILURE IN CHILDREN

Unhappily this condition is by no means rare in children, and it results from a rheumatic infection of the endocardium. The diet must be on the same lines as for adults but, because of the higher metabolic rate and the need for storage material for growth, proteins of good biological value, such as milk, eggs, and white fish, are required in greater proportions than for adults. When estimated on weight, a child needs 2 to 4 grammes of protein per kilogramme of body weight daily, whereas an adult needs only 1 to 1·5 grammes; and the total Calorie requirements for a child is 45 per kilogramme of body weight daily, as against 30 for adults. Mineral salts must be adequate, especially calcium for bony growth and the development of healthy teeth, and iron if there is a tendency to anæmia. Sodium chloride, however, must be restricted and so also must fluids, on account of the liability to œdema.

DIET IN CONVALESCENCE

After the main symptoms of venous congestion have subsided an additional period of rest in bed, lasting for three weeks to several months, is required in every case of congestive heart failure. During this period the Calorie intake is increased and the character of the food gradually becomes that of a light mixed diet of from 1,500 to 2,000 Calories. Large meals are badly tolerated because of the tendency to portal congestion. Bulky foods of slight nutritional value must be excluded, and fluids should be limited and should be taken between, rather than with, meals. The use of tea and coffee should be restricted and it is wise to give up tobacco and alcohol altogether.

CORONARY ARTERY OCCLUSION

The blocking of a coronary artery by a blood clot is a condition of sudden origin and necessitates absolute rest in bed for a minimal period of six weeks. For the first twenty-four to seventy-two hours morphia in full dosage is required to relieve the pain, and symptomatic treatment for shock must be given. During this time no solid food should be given. From 35 to 50 ounces of fluid, including sweetened fruit juices, milk, and broths, may be given daily unless persistent vomiting is present, when sips of iced soda water may give relief; and glucose solution may be given by intravenous drip. After the first few days ice-cream, junket, custard, cereals, strained vegetables, purées, and toast may be added gradually until five small meals are taken daily. Larger meals put too great a strain upon a heart with an inadequate coronary circulation and may result in heart failure. The extra demands of the digestive organs and the stimulation of metabolism after a heavy meal are estimated to increase the work of the heart by almost one-third during the first fifteen minutes, and it remains at this level for several hours. On the other hand, with prolonged undernutrition the metabolic rate is lowered and the work of the heart is diminished to a greater extent than can be achieved by rest in bed alone. No ill effects have been found to result from a moderate degree of undernutrition lasting from three to twelve months provided that the diet is well balanced and that the patient is not already undernourished. In fact a large proportion of patients with coronary artery occlusion are thick-set, overweight people and the loss of one or two stone of superfluous weight greatly eases the burden on the heart.

A low Calorie diet that has been advocated for coronary artery occlusion contains only 50 grammes of protein, 80 to 100 grammes of carbohydrate, and 30 grammes of fat, giving a total of 800 to 900 Calories per day. After the first four to six weeks this is gradually increased to 1,200 and by degrees to 2,000. These patients seldom suffer from hunger. All food, however, must be eaten slowly and be well masticated, and after the two main meals of the day a rest or a short sleep is beneficial. The angina of effort often follows coronary thrombosis, and attacks are prone to occur when exercise is taken soon after a meal.

An example of a well-balanced low Calorie diet is as follows:

Breakfast—Small serving of fruit without sugar, or two tablespoonfuls of cooked cereal with milk; one slice of bread or toast with a small pat of butter; weak tea or coffee without sugar or cream, a little milk being allowed.

Midday—5 ounces of broth or clear soup; 2 ounces of lean meat, fish, or chicken; 3 ounces of vegetables; half a slice of bread and a small helping of fruit.

Tea—One slice of bread or toast with a small pat of butter, or two biscuits; a cup of tea.

Supper—1 ounce of cheese or one egg; 3 ounces of vegetables; half a slice of bread; one glass of milk.

ARTERIOSCLEROSIS AND HYPERTENSION

The hardening and narrowing of the arteries in arteriosclerosis is associated with hypertension, but there is some difference of opinion regarding the relationship of the two conditions, especially as to whether the hypertension is caused by, or is the cause of, arteriosclerosis. But however that may be, the heart requires to exert considerably more pressure in order to force the blood through the narrowed vessels than through normal ones, and this inevitably raises the blood-pressure. Cardiac failure, cerebral hæmorrhage, angina pectoris, and nephrosclerosis occur as a result of long-standing hypertension, with consequent danger to life. Many people with arteriosclerosis tend to be overweight, and when obesity is associated with hypertension the patient's condition is improved if a low Calorie diet is given until the weight is reduced to normal, or even slightly subnormal. This should not be done too suddenly. The loss of one to two pounds weekly is quite sufficient and this should be checked by weekly weighings. On the other hand, the thin, tense, highly strung person with high blood-pressure will often become more relaxed and attain an improved nervous stability if the diet is increased and well balanced; and the arterial tension is then lowered.

Formerly, a low protein diet was advocated in cases of hypertension and meat was almost excluded from the dietary. Many physicians do not now advise this unless there is marked impairment of kidney function, hindering the elimination of the end products of protein metabolism; but in any case, as all proteins are reduced to amino-acids in the alimentary tract, it matters little whether these

amino-acids are derived from milk, eggs, fish or milk as far as the hypertension is concerned. If animal protein is restricted and the patient does not receive sufficient for his nutritional needs he will suffer from anæmia and his vigour and sense of well-being will be impaired.

The modern treatment of hypertension—in the absence of serious renal impairment—is to include 75 to 100 grammes of animal protein, in the form of meat, eggs, fish, milk, and cheese, and an abundance of fruits and green vegetables, so that mineral salts and vitamins are not deficient in the diet. Pickles, spices, curries, rich pastries, and fried foods should be avoided, and although most patients with hypertension have good digestions they should not overeat at any time. The evening meal, especially, should be light and simple. Alcohol need not be prohibited if taken in strict moderation, but smoking must be curtailed or completely discontinued. If possible, an hour's rest, lying down, should be taken after the midday meal, and eight hours' sleep is advisable each night. If, however, renal involvement is marked the dietary measures recommended for nephrosclerosis should be followed.

DIET IN DISEASES OF THE BLOOD

Diseases of the blood have been completely reclassified in recent years in the light of extended knowledge regarding their causation and treatment. Those due to a deficiency of iron or of vitamin C must still be treated by dietary measures, whereas the pernicious anæmias, which formerly relied upon the ingestion of large amounts of mammalian liver for their successful treatment, are now controlled by parenteral administration of extracts of liver or of hog's stomach.

IRON DEFICIENCY ANÆMIA

This type of anæmia is also known as chronic nutritional hypochromic anæmia. It is fairly prevalent among women of the poorest classes of the community, especially during the child-bearing period of life.

Iron is known to be necessary as a component of the hæmoglobin molecule, for without it the transport of oxygen by the blood cannot take place. It is required also for other processes not so clearly

defined. It may stimulate the development of mature erythrocytes from the normoblasts in the red bone marrow and it is said to be a constituent of certain enzymes that take part in cellular oxidation, and of the nuclei of all animal cells. Only very minute quantities of iron are normally excreted or are destroyed in the body. It is used over and over again, being stored in the liver when the hæmoglobin of worn-out red cells is finally disentegrated in that organ. So that it is principally as a result of abnormal loss of blood from the body that an iron deficiency anæmia occurs. In women, the loss of blood during menstruation and childbirth—especially if the former is excessive or a severe post-partum hæmorrhage occurs during the latter—may lead to a marked iron deficiency. During pregnancy the needs of the developing fœtus may reduce the iron content of the mother's blood, because iron must be stored in the baby's liver in sufficient quantities to supply its needs until it can take a mixed diet—for milk, both human and cow's, is deficient in iron. Babies frequently exhaust their prenatal supplies of iron by the sixth or seventh month of life, and as they are still not ingesting foods that are rich in iron they may become pale, flabby, and listless; for as they are increasing in size and the blood-volume becomes greater their need for iron is also increasing. Patients with gastric or intestinal conditions associated with hæmorrhage, especially when their main article of diet is milk, are apt to develop an iron deficiency anæmia unless steps be taken to supply this necessary mineral in adequate amounts. Repeated nose bleedings and the loss of blood from bleeding hæmorrhoids, or any other form of chronic hæmorrhage, will result in iron deficiency anæmia.

Naturally, possible avenues of blood loss must be investigated and treated before the anæmia can be cured; and once it has developed dietary treatment is not sufficient to correct it. The cheapest and most effective way to treat the condition, once it is well established, is to give iron in medicinal form; but prevention is better than cure, and recurrences often take place in a patient who has been given a course of iron treatment; so that a dietary survey should be made in each case and adjustments should be suggested, with due regard to relative costs and amounts of available iron in various foods. A dietary intake of 10 milligrammes of iron a day will supply the needs of the majority of women whose menstrual periods are normal and whose pregnancies are infrequent. Some women require 12 to 15 milligrammes

per day and even that amount is insufficient during pregnancy; but it is quite easy to obtain these quantities in foods if they are chosen with knowledge. Among the cheaper flesh foods with a high iron content are, in order of the amounts present, liver, corned beef, beef sausage, rabbit, herrings, eggs, and sardines. Among cereals, oatmeal and wholemeal flour have the greatest amounts. The 85 per cent extraction flour that was used between 1942 and 1944 and was again introduced in 1946 contains 50 per cent more iron than the 80 per cent extraction flour that was used in the interval between these dates, and more than twice as much as in white flour. Lentils are the richest sources of iron among the cheaper vegetables, but split peas, raw cabbage, leeks, turnips, onions, and potatoes are all iron-containing foods that are within the reach of the lower income groups. Oatmeal, brown bread, cocoa and chocolate have a relatively high iron content. A diet in which these foods are abundantly present corrects not only the deficiency of iron but also the deficiency of animal protein, calcium, phosphorus, vitamins, and roughage that are usually found to be present simultaneously. For this reason, dietary treatment is preferable to medicinal treatment in mild cases, whilst in severe cases both forms of treatment are necessary.

A diet of low cost but with a high iron content might be arranged for one day as follows:

Breakfast—Oatmeal porridge; national bread with butter or vitaminized margarine and syrup.

Dinner—2 ounces of liver, sausage, corned beef, rabbit or lean meat; boiled potato in its skin and cabbage; raw apple or orange; milk pudding with half an ounce of cereal.

Tea—National bread, oatcake with butter, syrup or jam.

Supper—Lentil soup, herring, cheese, or an egg; with bread, potato, or vegetable salad.

Pickles, vinegar, curries, and highly seasoned foods should be avoided in anæmia. If medicinal iron is given it is usually ordered for one week in each month rather than to be taken continuously. When cost of foods is not a very important consideration other foods with a high iron content can be introduced into the diet. Some of these are dried apricots, peaches, dates, and raisins, almonds, walnuts, oysters, olives, spinach, watercress, artichokes, cherries, and plums.

The majority of patients with an iron deficiency anæmia are constipated owing to lack of roughage and vitamin B in the diet that was

taken before treatment commenced, and to poor gastro-intestinal tone. The suggested diet should help to correct this, but liquid paraffin, agar, or small amounts of senna or cascara may be ordered in the early stages of treatment. Yeast tablets, taken before meals, will often be found to improve the tone of intestinal musculature.

Vitamin C is now recognized as an essential factor for blood regeneration, so that in all cases of anæmia it is important that the diet contains adequate amounts, or that ascorbic acid tablets are given. It is significant that the anæmia of scurvy does not respond to iron administration, although an improvement is quickly seen when adequate amounts of vitamin C are given. Additional quantities of this vitamin are also required in the dietary of patients with purpura, when subcutaneous hæmorrhages occur owing to increased permeability of the capillaries; and milk should be taken as freely as possible by these patients on account of its high calcium content.

CHAPTER 21

DIET IN DIABETES MELLITUS

In the years that followed the introduction and establishment of the use of insulin practically every case of diabetes mellitus was treated by a strict regulation of diet, especially with regard to starches and sugars, combined with regular insulin administration; and it was thought that, once started, insulin would invariably be required throughout life. This outlook has been considerably modified and the aim is now to control the condition by diet alone wherever possible and to give insulin only in those cases where the dietary treatment fails to keep down the percentage of sugar in the blood and maintain a 'sugar-free' urine.

PATHOLOGY OF DIABETES MELLITIS

The primary cause of the disease is failure of the islets of Langerhans, in the pancreas, to secrete their hormone—insulin—in sufficient quantities to control the metabolism of starches and sugars and, indirectly, of fats and proteins. The percentage of sugar in the blood rises and the kidneys attempt to excrete the excess. It therefore appears in the urine and, in order that it may be excreted without undue irritation to the kidneys and urinary tract, large quantities of water are also excreted to reduce its concentration. The sugar that is normally present in the blood is merely in course of transit from the liver to the muscles, where it is combusted, giving heat and muscular energy; so that the amount in the blood at any given time will fluctuate within certain limits according to the demands that are being made upon the muscles. The normal limits for blood-sugar are said to be between 100 and 180 milligrammes per 100 cubic centimetres—often expressed in medical literature and on patients' case-papers as '100 to 180 per cent', which students find difficult to understand without explanation; whereas in text-books of physiology it is often stated to be 0·1 to 0·18 per cent, which is, of course, exactly the

same as 100 to 180 milligrammes per 100 cubic centimetres. If it rises above this level the kidneys excrete it, so that 180 milligrammes per 100 cubic centimetres is regarded as the 'renal threshold'.

With a deficient secretion of insulin there is failure to store glycogen in the liver and an inability to utilize glucose in the muscles; although this substance is present in excess in the blood. The derangement of carbohydrate metabolism results in an abnormally high metabolism of fats and proteins, both to some extent probably being converted into carbohydrate, much of which is lost in the urine; so that the patient may lose weight in spite of a voracious appetite. Also, as the combustion of fats is imperfect in the absence of normal carbohydrate combustion, there is an accumulation of the intermediate products of fat combustion—oxybutyric acid, diacetic acid, and acetone, collectively known as ketone bodies. The presence of abnormal quantities of these substances in the blood is thought to be a prominent factor in the causation of diabetic coma; but the ketosis does not fully explain the chain of events, for in other circumstances an equally high concentration of ketones may occur without producing any such drastic effect upon the central nervous system. The untreated diabetic patient is often dehydrated, partly because of the large amount of water excreted by the kidneys, and this results in a diminution of the alkali reserves of the body; which may be as important as the ketosis in producing the condition known as 'acidosis', although the blood never really becomes acid, or even neutral, in reaction.

PRINCIPLES OF DIETARY TREATMENT

The arrangement of diabetic diets is such a specialized procedure that it is not intended that full details should be given in this book, especially as the subject is adequately covered in the current edition of *The Diabetic A B C*, by R. D. Lawrence; which also includes all the necessary tables of food values and many recipes for appetizing diabetic dishes. So that an explanation of the general principles that underlie dietary treatment is all that will be attempted here.

Most people consume more food than is necessary to maintain their weight and to supply the energy required for their various activities. The excess, if it cannot be combusted and dissipated as heat, is stored as fat. This extra combustion and storage must be avoided in the diabetic patient, for he has difficulty in metabolizing

food, especially carbohydrate. The ideal weight for a person with diabetes mellitus is said to be 10 per cent less than the average for his age and height; so that the first principle in constructing his diet is to reduce his weight if it is above the desired level and to avoid giving more food than he actually needs. Secondly, the proportion of carbohydrate to fat and protein must not be unduly restricted, for if it is reduced below a certain minimum the fats are inadequately combusted and ketosis results. Moreover, a high proportion of fat makes a diet unappetizing and somewhat nauseating and, whilst it is still held that the defective pancreatic function cannot be completely cured by any line of treatment, it has been suggested that carbohydrate is a stimulus to insulin formation and that it should, therefore, be given up to the limit of the patient's tolerance. If it is not possible to keep the urine sugar-free by diet alone, an adequate amount of insulin must be given, for underdosage defeats its own end. Thirdly, the diet must be adequate in vitamins and minerals.

When a patient with mild diabetes first comes under treatment, a 'test diet' might be arranged with the object of getting him sugar-free without insulin. This may not contain more than 85 grammes of carbohydrate and will be of low Calorie value—probably not exceeding 1,500 per day—so that it is not suitable for prolonged use. On the the other hand, if the patient when first seen is considerably underweight and has acetone as well as sugar in the urine, a restricted diet would probably increase his ketosis, so he is usually given a diet containing 130 to 140 grammes of carbohydrate with 100 grammes each of fat and protein, and the required amount of insulin is prescribed to enable him to metabolize it.

All food in the diet of a diabetic patient must be accurately weighed after being cooked, or otherwise prepared for the table, except that bacon can be weighed before cooking if all the fat from it is eaten; and flour, rice, sago, tapioca, oatmeal, and macaroni are weighed raw unless otherwise stated in the diet sheet.

The test diet that is given to a mild case of diabetes in order to ascertain whether the urine can be rendered sugar-free on diet alone, or to what extent the glycosuria can be reduced, may contain 85 grammes of carbohydrate, 70 grammes of protein, and 93 grammes of fat, giving a total of 1,500 Calories. It can be arranged as follows:

Breakfast—Bacon 1½ ounces, egg 1, bread 1 ounce; tea or coffee; milk and butter from ration.

Midday—Clear soup, Bovril or Marmite if desired; cooked lean meat 2 ounces; turnip, onion, or carrot $3\frac{1}{2}$ ounces; or lettuce, cress, celery, radishes, tomato, cucumber, cauliflower, French artichoke, French beans, marrow, cabbage, spinach, or brussels sprouts, 7 ounces; 1 orange or 2 Ryvita biscuits, with butter from ration.

Tea—Bread 1 ounce or 3 water biscuits; cheese three-quarters of an ounce or 1 egg; vegetable salad $3\frac{1}{2}$ ounces—without beetroot, potato, or peas; tea; milk and butter from ration.

Supper—Cold lean ham $1\frac{1}{2}$ ounces; or steamed white fish 3 ounces; or tinned salmon 2 ounces; any vegetable mentioned for the midday meal but only half the given quantity; bread 1 ounce; tea or coffee if desired; milk and butter from ration.

The daily ration of butter is 1 ounce and of milk half a pint. Saccharin may be used for sweetening provided it is added after the food is cooked, for it becomes bitter when cooked.

If, after a few days on this diet, the urine becomes sugar-free, additional Calories and carbohydrate are gradually introduced up to the patient's required maintenance level, which will depend upon his age, height, and particular activities; and insulin is given only if glycosuria reappears before he has arrived at a diet that meets his requirements.

If, however, the test diet fails to overcome the glycosuria by the end of a week, doses of insulin are ordered and are gradually increased until the patient is sugar-free. It may then be found that his tolerance for sugar has improved and the insulin dosage can be reduced or even be omitted altogether. Needless to say, diabetic patients may drink as much water as they desire, and they should take at least four glasses in the twenty-four hours. Each patient, having been stabilized, must be given a detailed diet sheet for one day. Tables of 'exchanges' for the foods mentioned in the menu are also provided showing, for example, the equivalent amounts of various kinds of fish, kidney, or cold ham which may be taken for breakfast instead of $1\frac{1}{2}$ ounces of bacon and 1 egg; how much breakfast cereal, rice, macaroni, shredded wheat or Ryvita may be interchanged for the bread allowed; and what fruits may be substituted for the vegetables mentioned. Thus he can work out a very varied diet, but he must continue to weigh all his foods carefully on reliable scales for at least the first few months. Eventually, he may learn to estimate quantities so accurately that he is able to choose dishes and help

himself to the correct amounts whilst at table with other people; which is, at times, a great convenience, for he should be encouraged to go out to meals at friends' houses or at restaurants occasionally, and not to regard himself as an invalid.

Many workers find it advisable to take a carried lunch at midday. Sandwich fillings can also be listed in 'exchange' amounts of cheese, egg, lettuce, tomato, meat, fowl, or fish, and this, together with a fruit 'exchange' table, enables a wide variety of lunches to be arranged.

RATIONING CONCESSIONS

Early in the late war the Government appointed a special committee of experts to consider the particular dietetic needs of people suffering from various ailments. One of the first problems to be attacked was the special modifications required by diabetics; for these people could not substitute carbohydrate foods, such as bread, potatoes, and cereals, for the restricted proteins and fats. It was decided that all diabetics, on the production of a medical certificate, could obtain extra meat, cheese, butter, and margarine in lieu of their sugar ration, but no extra allocation of bacon, eggs, or oranges and other rationed fruits was considered justifiable. Reconstituted dried egg can, however, be used just as well as shell eggs in a diabetic diet and extra milk *may* be prescribed if the physician considers it to be necessary. Patients who are having insulin can take practically a normal diet, with an increase in the insulin dosage when necessary; but no distinction is made between diabetic patients on insulin treatment and those on a strict diet without insulin as far as rationing concessions are concerned; so that a diabetic either gives up his sugar ration entirely and obtains the special rations that are allowed or he manages on the ordinary rations and insulin, plus any additional milk or eggs that the physician feels justified in prescribing. If nausea and vomiting occur and ketosis appears imminent, so that it becomes necessary for insulin and carbohydrate to be given almost exclusively for a time, an emergency supply of sugar may be obtained immediately after having produced a medical certificate at the local food office; three rations of sugar being allowed instead of the meat, bacon, fat, and cheese for the following week. No special concession is made to allow diabetic patients on insulin treatment to carry lump sugar

with them in case of insulin reactions; but glucose and boiled sweets are equally effective. The former can be obtained as vita-glucose tablets.

The present weekly rations for diabetics, in lieu of the sugar ration, are three rations of butter and margarine, making 18 ounces in all, but no extra cooking fat. The total fat, including that on the meat ration, thus amounts to at least 100 grammes daily, which is an adequate allowance. Whenever the ordinary meat ration falls below 1s. 6d. a week the diabetic has two extra meat rations, but when at or above that figure he has only one extra ration; and at all times he obtains 12 ounces of cheese a week. Many druggists give priority to diabetics with regard to supplies of saccharin and sugarless chocolate on production of evidence that they are suffering from this disease.

For all special rationing concessions forms need to be filled in periodically by the physician, and this gives an opportunity for the patient to be examined, his dietary record to be inspected, and adjustments made where the doctor considers this to be necessary.

DIET IN TEMPORARY INDISPOSITION

Whereas an ordinary person suffering from a minor ailment such as a common cold or a mild gastro-intestinal upset may safely follow his own inclinations with regard to diet, some special thought needs to be given to a diabetic in like case. A soft diet containing 150 grammes of carbohydrate, 50 grammes of protein, and 50 grammes of fat will provide about 1,300 Calories; and it can be supplied by 3 ounces of bread, which may be toasted, one egg, half an ounce of butter, half an ounce of oatmeal, 3 oranges or their 'exchanges', and 2 pints of milk. This can be divided into three small meals served in any form that is acceptable to the patient. He should, of course, be resting, so that no allowance is necessary for extra muscular activity. If he is reluctant to take even this restricted diet it is specially necessary to carry out urine tests not only for sugar but also for acetone and diacetic acid and to inform the physician if these substances are present. It is often found that a superadded infection may render the temporary administration of insulin a necessity in a patient who has not hitherto needed it, or an increased dosage may be required where it is already a part of the treatment.

THE USE OF INSULIN

Unless hyperglycæmia and glycosuria can be controlled on a diet that is adequate to maintain the patient's health and efficiency some form of insulin therapy must be instituted, although the expense of insulin, the inconvenience of its hypodermic administration, and its possible dangers render it desirable to do without it if it is safe to do so. On the other hand, an undue delay in starting insulin may mean that larger doses will be required and the degree of carbohydrate intolerance may become progressively lower.

Three forms of insulin are now in general use—(1) the original soluble, or unmodified, insulin; (2) zinc protamine insulin; and (3) globin insulin.

SOLUBLE INSULIN

This needs to be given 20 to 30 minutes before meals, so that three injections a day are necessary. Its action begins about 15 minutes after injection, the maximum effect being reached in about three hours, and thereafter its action slowly subsides until in six to eight hours after injection, no effect is demonstrable. In a severe diabetic whose insulin production has practically ceased, soluble insulin must be injected before each meal and, even then, the effect of the evening injection may wear off before morning, so that some degree of ketosis is liable to occur.

ZINC PROTAMINE INSULIN

In 1935 it was discovered that insulin would combine with a monoprotamine obtained from the ripe sperm of fish belonging to the trout and salmon species, and that the resulting compound could be prepared in a suspension that would be broken down very slowly in the body, producing a gradual fall in blood-sugar extending over a much longer period than when unmodified insulin is given. It was, however, rather too unstable to be put on the market. Two years later it was shown that it could be rendered chemically stable by the addition of a small amount of zinc, and as zinc protamine insulin it was issued commercially in 1937. Its action is not apparent for at least three hours after injection, for the insulin is gradually released from its combination with the protamine over a period of about

twenty-four hours. Thus it is possible to obtain a fairly constant liberation of insulin into the circulation with only one injection a day, and even then the effect upon the blood-sugar needs watching because of the tendency of the zinc protamine insulin to be cumulative in its action; and it may be necessary to redistribute the carbohydrate in the daily diet, giving the maximum amount with the evening meal in order to avoid a hypoglycæmia during the night or in the early morning. The hypoglycæmic attacks may, however, come on at almost any time during the twenty-four hours, their onset is more insidious than when soluble insulin has been given, and there may be successive attacks on the same day unless a constant intake of sugar is maintained, whereas recurrent attacks never follow an injection of soluble insulin. A second disadvantage to the giving of a single daily dose of zinc protamine insulin before breakfast is that owing to the time that elapses between the injection and the beginning of its action it may be found that hyperglycæmia may occur an hour or two later, before the insulin is sufficiently mobilized to deal with the carbohydrate that has been ingested. This can be avoided by giving a small dose of soluble insulin at the same time as the zinc protamine insulin, to cover the period before the action of the latter commences. Its great advantages, particularly in the treatment of children, are in reducing the number of injections to one a day and the fact that a smaller dose is required—approximately two-thirds of that needed when soluble insulin is given. Owing to its delayed action, zinc protamine insulin cannot, however, be used in the treatment of diabetic coma.

GLOBIN INSULIN

This is the most recent development in insulin therapy, and its exact place in the treatment of diabetes is not yet fully established. It was first prepared in research laboratories in 1939, but it was not available commercially in this country until August 1943. Globin is a simple protein derived from red blood-cells by the removal of their chromogen fraction. It combines with insulin to form a clear, yellowish solution. It is intermediate in the duration of its action between soluble insulin and zinc protamine insulin, being at least twice as long as the former and four to six hours shorter than the latter. Its action commences within two hours of its administration

and its maximum effect is reached between the second and eighth hour. It is as stable as soluble insulin, it can be kept as long as eighteen months under suitable conditions and it can be warmed to blood heat, if necessary, before injection. The dosage required is about one-third to one-half that of soluble insulin, and it can be given in a single dose about 45 minutes before breakfast. Because of its slower action during the first few hours after administration, a suitable distribution of carbohydrate in the dietary may be: breakfast, one-fifth; midday meal, two-fifths; early evening meal, two-fifths. A late evening meal is inadvisable. Occasionally a hypoglycæmia may occur in the late afternoon but this may be avoided by a rearrangement of the carbohydrate intake, giving one-sixth with breakfast, one-half with the midday meal, and two-sixths with the evening meal. Globin insulin is unsuitable in diabetic coma because it has a slower action than soluble insulin and because it cannot be given by any other route than subcutaneously, whereas soluble insulin can be given intravenously in an emergency.

TECHNIQUE OF INSULIN INJECTION

Most patients can be taught to administer their own insulin. In fact only very small children, the blind, the senile, and the feeble-minded cannot learn to measure and administer it accurately and efficiently. It is desirable that an insulin syringe, rather than an ordinary 1 c.c. or minim syringe, should be used, for this is graduated in units and provides a more accurate means of measuring the dosage and helps to avoid mistakes in calculation. It usually shows two scales of measurement, either for 20 and 40 units to the cubic centimetre or 40 and 80 units to the cubic centimetre. The cubic centimetre is divided into 20 cross-sections, each representing 1, 2, or 4 units according to the strength of insulin used. There is a tendency, at the present time, to estimate fluid dosage in millilitres rather than cubic centimetres and syringes may be graduated in the former instead of the latter, but as the millilitre is equal to the cubic centimetre this should cause no confusion.

It must be seen that the patient is supplied with the correct syringe for his own treatment and its markings must be explained to him. Many patients keep their syringes and needles in a portable metal case with a screw top and containing surgical spirit, and they are

recommended to use surgical spirit for cleansing the cap of the bottle and their own skin. The spirit in the case should cover the whole syringe and needle and it should be changed when it is no longer clear, which is usually about once a fortnight. Care should be taken to eject all the spirit from the syringe and needle before drawing up the insulin, for it may cause an unpleasant stinging sensation when the injection is given. When patients complain of pain at the site of injection it is usually due to the fact that they are giving the injections too superficially, or too deeply so that the fluid is injected into the muscles. The loose, fatty subcutaneous tissue is the correct layer into which to make the injections and they should be made with a sharp, fine needle, Nos. 17 to 20 being the most suitable. The needle should be inserted well into this tissue and the piston must be completely depressed before the needle is withdrawn, for the deposition of insulin into the skin layer may be very irritating. As the needle is withdrawn, firm pressure should be made on the point of puncture for a few moments. Occasionally, a small vein may be punctured, but pressure for a little longer period will suffice to stop the bleeding. The site of injection should be continually varied, although if three injections are required each day it becomes difficult to avoid injecting into the same area rather too frequently. The best sites for self-injection are the outer surfaces of the thigh, the loose tissues of the abdomen, and the lower part of the chest, for patients can then use both hands. When the injection is given by another person the outer surfaces of the arms and forearms are suitable sites. Before using insulin its condition whilst in the bottle should be noted. Soluble insulin should be as clear as water and if it is cloudy it should be discarded. Zinc protamine insulin is turbid and milky-looking, with tiny particles that tend to sink to the bottom, so that the bottle should be gently shaken before use. Globin insulin should be a clear, yellowish fluid. When soluble insulin is given in addition to zinc protamine insulin, the former should be injected first; the syringe can then be disconnected from the needle—which is left in the tissues—a fresh needle is fitted to the syringe and the dose of zinc protamine insulin is drawn up. The syringe is then reconnected to the original needle and the second injection is given. Thus only one needle prick is made and the two forms of insulin are not mixed in the syringe. It has been shown that it is difficult to measure a dose taken from two rubber-capped bottles into the same syringe and, moreover, a propor-

tion of the soluble insulin may be converted into zinc protamine insulin when the two are mixed in the syringe. Special care must be taken to wash out solid particles from the needle after an injection of zinc protamine insulin has been given.

LOCAL REACTIONS

Immediately after an injection of soluble insulin has been given there is a slight stinging sensation in the area due to the acidity of the insulin, but this is less marked with zinc protamine insulin, which is alkaline in reaction. Every injection of insulin produces a slight swelling that may persist for several hours, and in some patients the injection of zinc protamine insulin is followed by the appearance of small lumps that may persist for several days.

Local allergic reactions follow in a small minority of cases, due to the protein content of the insulin. As with all allergies, the reaction does not occur after the first injection. Usually by the end of a week from the commencement of the injections, large, red, intensely irritating swellings appear; but as the patient becomes desensitized to the foreign protein these allergic manifestations disappear, the desensitizing process usually taking several weeks.

Cases of sepsis following insulin injections are rare, but occasionally abscesses form after the administration of zinc protamine insulin, usually due to faulty technique in the preparation and giving of the injections.

Fat atrophy is a curious local reaction that develops, although rarely, near the site of the injections, the fat under the skin disappearing and leaving hollows. Women and children are more prone to this reaction than men. It can usually be avoided by using the solution of insulin containing 80 units per c.c., and by not giving two injections in the same place within four to six weeks of each other.

BLOOD-SUGAR BALANCE

All patients taking insulin should have the symptoms of hypoglycæmia and hyperglycæmia carefully explained to them, and should know what immediate steps to take if either of these conditions threaten to develop. The former, which results from overdosage of insulin or the giving of insulin that is not followed by the intake of carbohydrate, is often produced experimentally before the patient leaves hospital; so that he experienced the symptoms produced,

which are not the same in all patients. He is then given sugar in some form, when he obtains immediate relief and the symptoms rapidly disappear. Hyperglycæmia develops much more slowly and produces the characteristic symptoms of diabetes itself, for which the patient originally sought medical advice, so that he is unlikely to fail to recognize them. Both conditions, if untreated, lead to coma; that produced by hypoglycæmia developing much more rapidly than that of hyperglycæmia.

AVOIDANCE OF ERROR IN THE USE OF INSULIN

Since there are three types of insulin on the market and each is available in different strengths, some method of distinctive labelling was seen to be desirable. To meet this need there has been introduced a system of coloured labels and packings which is followed by all firms of manufacturing chemists preparing insulin for the market. Soluble insulin has one colour only in its packings and labels, but this varies with the strength of the preparation—buff being used for 20 units to the cubic centimetre, blue for 40 units, and green for 80. Neither of the other preparations is supplied in 20-unit strength, but all packages of each have parti-coloured labels. The first colour is the same as for soluble insulin of the same strength, the second colour for zinc protamine insulin being pink, and that for globin insulin being orange. The two colours are arranged in diagonal sections. Thus zinc protamine insulin 40 units to the cubic centimetre has a blue and pink label, whilst 80 units to the cubic centimetre has a green and pink label. Globin insulin 40 units to the cubic centimetre has a blue and orange label, and 80 units to the cubic centimetre has a green and orange label. It is not only in the purchase of insulin that error needs to be guarded against, for when a single dose of zinc protamine insulin is supplemented by a small dose of soluble insulin given at the same time it would be quite easy inadvertently to reverse the amounts prescribed unless the labels were distinctive.

CARE OF THE GENERAL HEALTH OF THE DIABETIC

The general health has a marked effect upon the progress of diabetes mellitus. The patient must have sufficient rest, sleep, and

exercise. Exercise raises the sugar tolerance and lessens the amount of insulin required, but unusual exercise may cause an attack of hypoglycæmia by using up the blood-sugar. Every patient who is taking insulin should carry a few lumps of sugar with him and take it directly he realizes the necessity for it; and having once experienced the symptoms of insulin overdosage he will recognize them at once, although they differ somewhat in different people. Diabetics have a lowered resistance to infection; they are prone to boils and carbuncles and easily fall victims to tuberculosis, so that infection must be avoided whenever possible. The skin and the nails need hygienic care; bruises, cuts, and other small injuries should receive prompt attention; corns and hardened skin must be treated, and dental caries prevented. The functions of the skin, bowels, and kidneys must be maintained, but purging avoided because it deprives the body of fluids and alkalis. Elderly diabetics usually have some degree of arteriosclerosis resulting in poor circulation and undernourishment of the tissues. This increases the liability to diabetic gangrene. Any sign of discoloration or inflammation of the toes or feet should be reported instantly. The diabetic must give special consideration to the question of holidays, and should not leave home unless he is certain that he can carry on his diet satisfactorily in his holiday surroundings, for correct diet is more important to the diabetic than is change of air and scenery.

DIABETES IN CHILDREN

Although diabetes may occur at any age, it is relatively uncommon in children, who are too young to understand and co-operate in the treatment that is necessary. Difficulties in treatment arise from the fact that the child's nutritional needs are constantly altering owing to his physical growth and development, and it is therefore impossible to stabilize him on a standard diet with a fixed dosage of insulin. He needs a diet relatively higher in proteins, carbohydrate, minerals, vitamins, and total Calories than an adult, but an increased fat intake favours the production of ketosis and may result in the passing of fatty stools. Green vegetables in large quantities may cause digestive troubles. Moreover, a child's temperature is much less stable than an adult's, and this results in a more variable sugar tolerance; and the acute infectious fevers to which children are liable intensify

the problems of dietetic treatment. When children develop diabetes it is usually in an acute form, and insulin appears to have a more violent action, producing an unusually rapid fall in blood-sugar which is followed by an equally rapid rebound.

The child must be given a diet that is adequate for his energy requirements as well as for his normal growth; and if it is insufficient to appease his hunger he will probably take forbidden food surreptitiously; also, on an inadequate diet his resistance to infection will be lowered, his liability to develop tuberculosis will be increased, and his mental as well as his physical development will be retarded. For all these reasons it is seldom that diabetes in a child can be treated by diet alone; in fact many physicians would not attempt to do so. The child must be treated as an intelligent being if his co-operation is to be ensured, and he must be taken into the confidence of his doctor and his parents regarding his condition and its treatment. The acquirement of good diabetic habits inculcates a training in self-control and discipline that may have a marked influence upon his character development; and in that respect the restrictions imposed may not be an unmixed evil. Many children can be taught to prepare and administer their own insulin and to carry out the urine test for sugar. Special clinics are established, many of them residential, in which a child can be trained in the régime he may have to follow throughout his life, and in the company of other children who must all learn to make the same adjustments. Not the least advantage of such group training is that the child does not consider himself as different from everyone else or under a greater handicap than others. He realizes that his condition is no reason why he should not live a normal life and grow up into a healthy adult.

In prescribing the diet the same general principles are borne in mind as when arranging a diabetic diet for an adult. The food should be simple and, as far as possible, it should include the articles that children generally enjoy. A child of 5 would need 140 grammes of carbohydrate, 60 grammes of protein, and 70 grammes of fat, which would give 1,470 Calories. A Calorie increase of 5 to 10 per cent every 6–12 months is needed in order that he may grow 2 inches in height and 6 pounds in weight each year. It is better to calculate diet requirements on age rather than height in diabetic children for they often grow very tall for their years although occasionally they remain short and fat. During adolescence the increase should be

10 to 20 per cent, and the arrangement of the meals and the dosage of insulin must be varied according to the changing routine of the individual child. Sample diet tables for children can be obtained, with tables of exchanges, and the child should learn to construct his own weekly menu as well as to administer his own insulin.

DIABETES IN PREGNANCY

In a diabetic woman the symptoms may become more severe during pregnancy. During the early months her glycogen reserves may be depleted by vomiting and, later, toxæmia and eclampsia develop more easily than in the non-diabetic. The fœtus may become unduly large as the result of the excessive quantities of sugar it receives from the maternal blood. All these dangers increase the need for dietetic adjustment and additional insulin; but a successful termination to pregnancy is quite common where good supervision has been given throughout.

The dietary requirements during pregnancy are similar in principle to those of a growing child. Little or no increase is necessary during the first few months, but after the fourth month 10 to 20 per cent increase in Calories may be needed, together with an increase in insulin dosage. Fat may be poorly tolerated, especially during the period when vomiting is likely to occur. Milk is the best source of extra protein during pregnancy on account of its high calcium content. Overfeeding is most undesirable at any time in a diabetic, but during pregnancy any factor that could contribute to the size of the fœtus must be avoided. Towards the end of the pregnancy some physicians advocate a reduction of sodium chloride intake and the giving of supplementary amounts of vitamins E and K.

CHAPTER 22

DIET IN DISEASES OF THE NERVOUS SYSTEM

It has been noticed that in many diseases of the nervous system symptoms are present that are similar to those of beri-beri and pellagra, and therefore the question arises as to how far conditions other than beri-beri and pellagra that affect nervous tissues may be influenced by increasing the intake of the vitamins in the B complex; although it is recognized that no cure is possible when structural damage has occurred. Apart from conditions with similar symptoms to those occurring in diseases due to vitamin B deficiency, the only disorders of the nervous system that appear to be improved by diet therapy are epilepsy and migraine.

There are, however, many food 'faddists' among neurasthenic and neurotic people who believe that certain foods are specially harmful to them, and who have developed dietary habits which exclude some essential food factor; so that investigation of the food intake and the prescribing and planning of a satisfactory diet should form part of the treatment of all diseases and disorders of the nervous system.

NERVOUS CONDITIONS ASSOCIATED WITH ANEURIN DEFICIENCY

It is undoubted that nutritional states have a great influence upon the integrity of nervous tissues. Slight degrees of dietary deficiency may lead to functional derangement, whilst more serious deficiencies, if long continued, may result in structural changes of a degenerative or destructive type. The absence of aneurin, or vitamin B_1, in a diet results in the development of the polyneuritis known as beri-beri and, although no diet in this country is likely to be so deficient as to lead to well-marked beri-beri, subclinical conditions are by no means rare.

Three chief types of the disease are recognized—(1) dry beri-beri, characterized chiefly by multiple peripheral neuritis; (2) wet beri-beri, in which general œdema and serous effusions predominate; and

(3) acute beri-beri, in which cardiac and respiratory failure are marked symptoms. Mixed types often occur in countries where the disease is endemic, and when beri-beri occurs in infants it is usually of the acute type and is frequently fatal.

The onset of the first two types is insidious, commencing with fatigue after slight effort, and pain and stiffness in the calf muscles. Then follows mental depression, irritability, lack of initiative, interrupted sleep, nightmares, loss of appetite, and gastric and intestinal discomfort. This syndrome so closely resembles the early stages of neurasthenia that it is small wonder that the latter condition often improves when aneurin intake is increased.

Later symptoms of beri-beri are peripheral neuritis and paralysis, but fully developed beri-beri is extremely rare in Britain, for it is due to long-continued deficiency of aneurin, and even the poorest diet is not without this substance, especially since a high extraction flour has been generally used. The growing proportion of special diets, however, renders it possible that minor degrees of aneurin deficiency may tend to increase. Those advocated for gastric and duodenal ulcers, for obesity, and for diabetes specially need to be watched in this respect. During pregnancy and lactation the requirements for aneurin are greatly increased, being four or five times the ordinary amount. Hyperthyroidism, infection, or any other condition which increases metabolism raises the need for aneurin and may precipitate an attack of beri-beri. A high carbohydrate diet also necessitates an extra supply of this vitamin but, seeing that the germ of wheat and other cereals is a rich source, the form in which the carbohydrate is taken may ensure the additional supply of aneurin. Only when glucose and other sugars constitute the main forms in which the carbohydrate is taken does any real danger occur. Other conditions associated with aneurin deficiency are hunger œdema and Korsakoff's syndrome.

HUNGER ŒDEMA

This has often accompanied wars and famines. It results from hard physical work on starvation rations, and although œdema is the most obvious symptom and is always present in the lower extremities but less often in the face and upper limbs, some degree of neuritis is also present.

KORSAKOFF'S SYNDROME

This involves the mental confusion, loss of memory, and irresponsibility that characterize chronic alcoholism, but it is now regarded as probably due in a greater measure to lack of aneurin than poisoning with the alcohol itself, for, according to recent research, alcohol does not have a direct effect upon nerve tissue, and both in Korsakoff's syndrome and in delirium tremens the injection of massive doses of aneurin (5 to 10 milligrammes daily),[1] together with nicotinic acid, has been followed by prompt general improvement and complete disappearance of the chronic alcoholic psychoses. The reasons advanced for the B complex vitamin deficiency in alcoholism are: (1) that the high Calorie value of alcohol necessitates an increased supply of these vitamins, (2) chronic alcoholics are notoriously neglectful of their diet, (3) gastritis causes incomplete absorption of both vitamins and minerals, and (4) liver defects interfere with their storage.

In addition to the conditions already mentioned, the neuritis that accompanies cachexia and senility is thought to be markedly influenced by aneurin intake. Nervousness, irritability, and diarrhœa in old people may be related to dietary inadequacies, and so also may psychic disturbances such as cerebral confusion, forgetfulness, depression, anxiety, or even a true psychosis. The deficiencies in the diet are usually related to the vitamins and especially those of the B complex.

NERVOUS CONDITIONS ASSOCIATED WITH NICOTINIC ACID DEFICIENCY

Nicotinic acid, the anti-pellagra factor that was once thought to be vitamin B_2 until that substance was found to have no influence upon pellagra and was named *riboflavin*, is present in much the same foods as is aneurin, the richest sources being yeast, liver, peanuts, and whole wheat. Salmon, poultry, milk, spinach, leafy vegetables, and bananas are fairly good sources.

The early symptoms of pellagra that are associated with the nervous system are weakness, lassitude, irritability, anxiety, and

[1] The normal daily requirements of aneurin are estimated at 1·5 to 2·3 mg. for men and from 1·2 to 1·8 mg. for women.

anorexia. Later, a muscular tremor develops, especially of the hands, the tongue, and the lips. Vague neuroses, diarrhœa, and skin lesions are also present, and eventually the whole of the nervous system is involved. Psychoneuroses such as manic depressive insanity and acute delirium may be present, as well as muscular palsies and paralyses.

A consideration of the many points of similarity between the symptoms produced by nicotinic acid deficiency and those of some of the chronic diseases of the nervous system should make obvious the desirability of excluding any nutritional defect that might influence the patient's condition before commencing any other line of treatment. To this end a diet should be planned that contains, at first, excessive amounts of the vitamins in the B complex and is very well balanced in all other respects; for dietary defects are rarely of one factor alone. The fact that the patient has anorexia creates a difficulty in giving an adequate diet. In these cases the giving of brewers' yeast in powdered or tablet form in relatively large doses—of 50 grammes or more a day—which can be suspended in cold fruit juice or water, will do much to stimulate appetite when its loss is due mainly to vitamin B deficiency, as well as to help in overcoming the deficiency itself. Parenteral injections of liver extracts have been found to be a valuable adjunct at this stage of the treatment. Vitamin B concentrates may also be given, but it is always better to arrange a diet that is adequate in all food factors rather than to give concentrates or medicinal preparations.

DIETARY TREATMENT IN DEGENERATIVE CONDITIONS OF THE SPINAL CORD

Combined posterolateral tract sclerosis, or subacute combined degeneration of the spinal cord, is now considered to be the most important of the nutritional diseases of the central nervous system. It occurs in combination with pernicious anæmia, with the severe forms of pellagra and beri-beri, and also with other spinal cord conditions that are of obscure origin. The modern treatment is that of pernicious anæmia, whether an anæmia is actually present or not. Liver extracts are given and are continued throughout the patient's life, together with the administration of aneurin and nicotinic acid either by mouth or by parenteral injection. The disease, which hitherto

had been considered to be progressive and to lead to irreparable damage to the spinal cord resulting in paraplegia, has sometimes been arrested by intensive anti-anæmia treatment combined with increased intake of the vitamins in the B complex.

DIETARY TREATMENT OF EPILEPSY

The chief of the diseases of the nervous system that have no relation to nutritional defects and that may yet be influenced by diet is epilepsy. There is evidence to suggest that the disease may be connected with a disturbance of the water balance and that the seizures are precipitated by lack of oxygen in the tissues and by alkalosis. Whether freedom from seizures is the more related to water depletion or to acidosis has not been finally determined. In many cases of epilepsy neither of these factors appears to influence the attacks. Two dietary modifications have, however, been used in the treatment of epilepsy—a dehydration and a ketogenic diet.

THE DEHYDRATION, OR DRY, DIET

The use of this diet is based on the theory that the convulsive seizures in epilepsy are brought about by increased pressure on the motor areas of the brain by accumulations of cerebrospinal fluid. Therefore the recommended diet is one in which there is a gradual reduction of total fluid intake to 20 ounces a day, or even less. Sweets and salt are excluded as far as is practicable, since both promote a craving for water, and salt encourages the retention of water in the body. In all other respects a normal diet is allowed, provided that fluids are rigidly restricted. The patient is given a diet such as the following, only three meals being allowed with no intermediate feeding:

Breakfast—Fresh fruit; dry cereal with cream or a measured amount of milk; an egg or fried bacon; buttered toast; 5 oz. of tea or coffee.

Midday—Meat, fish, or cheese; medium-sized potato; one other vegetable; custard or junket; bread or toast and butter.

Supper—Fresh apple, salad, or celery; a good serving of vegetable with grilled liver or fish; toast and butter with cheese if desired; measured quantity of tea, coffee, or other beverage.

The total fluids, whether taken as milk, tea, coffee, or other drink, must be measured, and watery fruits and vegetables must be counted as an equal weight of water.

The excretion of water is stimulated by the use of saline aperients and by encouraging the action of the skin.

It has been suggested that the patient should continue this diet for some weeks, or even months, and that after this period liquids may be cautiously increased up to the 'fluid tolerance point' of the individual patient, as shown by a tendency for the epileptic seizures to reappear.

THE KETOGENIC DIET

This diet was first used in 1921. It had been observed that fasting was a means of lessening the number and severity of epileptic attacks, and this action was attributed to the effect upon the nervous system of the ketosis that develops in starvation—the ketone bodies exerting an anæsthetic action on nervous tissues. But it is impossible to continue a starvation diet for long without seriously endangering the patient's general health. A consideration of the mechanism by which ketosis is produced in the diabetic patient prompted the suggestion that a ketogenic diet might be of value in the treatment of epilepsy. This diet contains an extremely small amount of carbohydrate, a normal quantity of protein, and a very large amount of fat. It is, therefore, unbalanced according to accepted standards of a well-balanced diet and, if continued for long, nutritional disorders may arise unless means are taken to guard against them. The deficiencies relate especially to mineral salts and to the water-soluble vitamins. It has been impossible to give a ketogenic diet since the strict rationing of fats and the complete absence of cream from the market; but as normal food supplies become available it will, no doubt, be again prescribed.

Unless the patient is already underweight the treatment usually begins with a period of fasting which lasts until the seizures have stopped, but should not be continued for more than a week. During this time the patient is kept in bed and is given only water, broths, and bran wafers with about 8 ounces of orange juice daily. The degree of ketosis that is developing must be watched by testing the urine for acetone and diacetic acid. The rapidity with which it develops

depends upon the amount of carbohydrate stored in the liver and the muscles. It is especially rapid in children and in undernourished persons. In constructing the subsequent diet one must first determine the Calorific needs of the patient and his normal protein requirements, which should be 1 gramme daily per kilogramme of body weight for adults, a higher allowance being necessary for children. Only from 10 to 20 grammes of carbohydrate are allowed at first, and this means that bread, potatoes, and other starchy foods and all sweets must be excluded from the menu. Bran wafers, which have no food value, may be eaten as much as desired, for they are a useful help in preventing constipation. The whole of the rest of the Calorie requirements is made up by fats, using butter, cream, salad oil, egg-yolk, and the fat of meat and fish; and in addition the patient may be induced to take a dose of a nutritive oil, such as cod liver oil or olive oil, at the beginning of each meal. This is less nauseating than mixing too much oil with the food.

The butter and other fats will supply adequate amounts of vitamins A and D, but because of the carbohydrate restriction it is difficult to give sufficient amounts of milk, cereals, vegetables, and fruits to supply the water-soluble vitamins B and C, or the necessary calcium, phosphorus, and iron. Brewers' yeast, Bemax, or Marmite may be given to make up the deficiency of the vitamins of the B complex, ascorbic acid tablets will supply vitamin C, whilst the minerals may be given in medicinal form, usually as tablets.

After three months' freedom from epileptic seizures the carbohydrate may be increased by 10 grammes daily each month until 80 grammes are taken. Thereafter the carbohydrate increases may alternate with 10 gramme increases of protein; and when the seizures have been completely under control for twelve months the fats can be slowly reduced.

The main difficulties to be overcome in giving a ketogenic diet are that patients find it unpleasant and nauseating, which makes its prolonged use somewhat difficult, and the excessive fat in the diet may produce gastro-intestinal disturbances. Much can be done to help in avoiding these difficulties by preparing and serving suitable dishes. For example, heavy cream with egg-yolk, but no sugar, may be frozen into ice cream. Meat fat can be taken more easily when cold than when hot. Bran wafers need much more butter to make them palatable than could be taken with bread or biscuits. Vegetables

such as spinach and cabbage should be cooked with as little water as possible and could be served with butter, whilst the water should be used in making cream soups. Tomatoes, lettuce, and cucumber are allowed and could be made into attractive salads, incorporating eggs and using mayonnaise or salad oil. Mushrooms and other vegetables of low carbohydrate value absorb large amounts of fat when sautéed, and gelatine or agar jellies can be taken with almost equal quantities of cream. Nuts and cheese have a high fat and mineral content and they can be used in many ways for introducing variety and adding to the palatability of a ketogenic diet.

Not all cases of epilepsy respond to treatment by diet. Children and adults who are just beginning to have epileptic seizures are more apt to show improvement than long-established cases. It has been estimated that if the diet is carefully followed for at least six months the seizures are controlled in about one-third of the cases, there is improvement in about one-third, whilst the remaining third derive no benefit and the treatment should therefore be stopped.

KETOGENIC DIET IN OTHER CONDITIONS

It has been suggested that the severe type of recurrent headache known as *migraine* may be related to epilepsy with regard to causation, and because of this the ketogenic diet has been tried in the former condition. A few cases have responded well to this form of treatment, whilst in many others the severity and frequency of the headaches have not been lessened. It is thought that the ketosis may prevent attacks by decreasing the irritability of nerves.

The ketogenic diet has also been advocated in *asthma* and occasionally it has been followed by marked relief from attacks. It is thought that in these cases the diet might have helped by excluding a food to which the patient was allergic.

The attempt to cure *chronic infections of the urinary tract* by giving a ketogenic diet is now practically abandoned. These patients find the diet particularly nauseating, and the same effect upon the urinary tract can be obtained by giving mandelic acid or a bacteriostatic drug such as a sulphonamide or penicillin.

CHAPTER 23

DIET IN SKIN DISEASES AND ALLERGIC CONDITIONS

That there is a scientific basis for assuming that diet is of importance in relation to some of the diseases of the skin is a view held by many specialists in this field of diet therapy, and in any case patients with skin affections, especially of the eczematous type, expect to be given a diet, or at least to be told what foods should be avoided and what should be taken freely.

Certain skin diseases are associated with vitamin deficiencies or with a high carbohydrate or a high protein intake. In some people the ingestion of shellfish, strawberries, or mushrooms is followed by an urticarial or erythematous rash, whilst in a true 'food allergy' not only rashes but attacks of gastro-intestinal pain, vomiting, and diarrhœa may occur. Milk, eggs, wheat, chocolate, tomatoes, oranges, and pork, in addition to the three foods already mentioned, are the commonest articles of diet that may lead to allergic symptoms; but pollen, feathers, hairs, kapok, glue, and various other trade products and household articles are also capable of producing similar reactions in sensitized people. There are, therefore, three chief dietary aspects in the treatment of skin diseases—the influence of vitamins, the limitation of carbohydrates or proteins, and the possibility of allergic tendencies.

THE INFLUENCE OF VITAMINS IN SKIN DISEASES

VITAMIN A

With deficiency of vitamin A the most characteristic change in skin structure is the disintegration of surface epithelial cells, followed by their replacement with a stratified, keratinized epithelium, so that the skin looks dry, shrivelled, and scaly. The hair may be dry and bleached, with a tendency to fall out; and around the hair follicles in regions other than the scalp there may develop hard, pigmented

lesions known as comedones or 'blackheads'. In the centre of a comedo there is a scaly, pointed plug of keratinized epithelium. This core can be pressed out, leaving a tiny crater. Keratinization of the cornea may occur, causing a condition known as *xerophthalmia*, or dry eye, which, if untreated by the administration of vitamin A in adequate quantities, may lead to blindness. It has been suggested that infantile seborrhœic eczema might sometimes be due to vitamin A deficiency, and it would appear that both in infants and adults an adequate intake of vitamin A may serve to maintain a healthy condition of the skin and render it less susceptible to diseases such as seborrhœa, acne, and eczema. In addition to the skin lesions that occur in vitamin A deficiency, there are changes in the mucous membranes that render them more susceptible to bacterial invasion, and so predispose to infections of the respiratory and gastro-intestinal tract.

VITAMIN B COMPLEX

The skin lesions that occur in association with deficient intake of the vitamins in the B complex are associated with lack of nicotinic acid rather than with lack of aneurin, or vitamin B_1. In fact no skin disease resulting from lack of the latter factor has been reported; although in a condition called acrodynia—characterized by erythema and neuritic pain—the intramuscular injection of aneurin has been followed by dramatic improvement. It has also been given to relieve the pain in herpes zoster. The dermatitis due to nicotinic acid deficiency is only one symptom in the pellagra syndrome and is not, therefore, considered as essentially a skin disease.

In some cases of persistent post-adolescent acne improvement has followed the administration of pyridoxine.

VITAMIN C

Scurvy, the classic disease caused by vitamin C deficiency, is not itself a skin disease but it is associated with areas of pigmentation and hardening of the skin, and by subcutaneous hæmorrhages. It has been suggested that the pigmentation in pernicious anæmia and in Addison's disease may be due to lack of vitamin C. The diet may not be deficient in this vitamin but its absorption and storage may be defective. Normally it is believed to be stored in the suprarenal

glands, and as these glands are the central focus in Addison's disease the suggestion that the pigmentation may be influenced by vitamin C is not surprising.

In the treatment of psoriasis the administration of vitamin C has been effective in some cases whilst others have shown no improvement; and the same can be said with regard to urticaria.

VITAMIN D

This is the specific remedy for infantile rickets, but it has also been given in massive doses in the treatment of psoriasis with more encouraging results than have followed the giving of vitamin C; although at least one-third of the cases have shown no improvement. In the treatment of acne vulgaris a larger proportion of patients have derived benefit from the administration of vitamin D, there being an improvement in the appearance of the skin and in general health, with an increased appetite and a gain in weight. Where no rachitic condition is evident this vitamin is best given in fish liver oils, for most proprietary preparations contain some form of calcium as well as the vitamin, and the giving of additional calcium when its previous intake and metabolism have not been defective may cause a rapid rise in blood calcium, with undesirable effects. Vitamin D is the only vitamin which, when given in excess, can cause pathological symptoms, and therefore its administration in massive doses cannot be continued indefinitely; although excessive amounts of other vitamins are excreted without causing harmful effects.

From the foregoing considerations it would appear that, although no vitamin is a specific remedy for any skin disease, it is always worth while to investigate a patient's diet and be sure that it is not deficient in any of these important food factors. It should also be borne in mind that it is almost always better to adjust the diet so that all vitamin needs are adequately met than to give concentrates of these substances; for it often happens that a diet that is deficient in respect of a vitamin is unsatisfactory in other ways as well.

THE INFLUENCE OF CARBOHYDRATE AND PROTEIN IN SKIN DISEASES

One of the main difficulties in the treatment of a skin disease by a strict diet is that the patients are usually ambulatory, whereas, in

order that the dietary régime should be accurately followed and the results correctly estimated, the patient should be admitted into hospital whilst the treatment is being carried out; and this is seldom an economic possibility.

The skin disease that appears to be most frequently aggravated by a high carbohydrate intake, especially of actual sugar, is adolescent acne, and the articles particularly incriminated are chocolate and white bread—which may account for the lower incidence of this condition during recent years in this country. It is significant that the adolescent usually partakes more freely of excess carbohydrates than do older people; but whilst in some young patients an over-indulgence brings on a fresh outbreak of acne pustules, in others the condition is not aggravated. It would appear that it is not the carbohydrate itself but the patient's idiosyncrasy to it that is the determining factor in the exacerbation. Most physicians, however, try the effect of limiting carbohydrates, giving the patient a list of permitted and of forbidden foods. The diet should consist principally of vegetables, fruit, wholemeal bread, milk, eggs, and white fish, with meat once a day only. The foods to be avoided are candied fruits, jellies, jams, syrup, all forms of confectionery, curries, highly spiced dishes, and alcohol. When a low carbohydrate diet is prescribed it must be emphasized that other foods should be increased to meet the patient's nutritional needs, otherwise a loss of weight will follow accompanied by lowered resistance, and this may lead to increased pustular eruption.

The chief skin disease that may be influenced by protein intake is psoriasis, for in carrying out studies in protein metabolism it has been found that many patients with psoriasis tend to retain nitrogen. In these cases a low protein diet has often been followed by improvement in, or even disappearance of, the skin lesions. The reason suggested for this is that, as all cells are dependent upon protein for their growth and multiplication and the main feature of psoriasis is a rapid growth, proliferation, and shedding of epidermal cells, the rate of growth of these cells must be proportional to the amount of protein available. If, therefore, only sufficient protein is supplied to meet the needs of the body as a whole there will be no extra protein to be utilized in rapidly multiplying the cells of the skin. On the other hand, it has also been suggested that the epidermal cells in psoriasis, like those of a malignant growth, have the power to prey upon the

food reserves of the rest of the body, which may explain why some cases of psoriasis are entirely uninfluenced by a low protein diet as far as the skin lesions are concerned, and the patients may complain of loss of muscular strength and wasting of the muscles as the result of restriction of proteins.

FOOD ALLERGY

FOOD ALLERGY

A food allergy is a phenomenon in which a small minority of persons are sensitive to a given food which the great majority can eat with no ill effects. This sensitivity shows itself in a variety of ways, and even minute quantities of a particular food may cause severe symptoms to develop. In other cases the sensitivity is less marked, so that the food must be taken in larger amounts or on several days before symptoms appear, and these may be quite mild. Sensitivity to a certain food is more frequently seen in young children than in adults. The ill-effects of a food allergy may be manifested by:

(*a*) Skin symptoms, such as urticaria, erythema, or eczema.

(*b*) Respiratory symptoms, such as asthma, hay fever, and bronchitis.

(*c*) Nervous symptoms, such as migraine and epileptic convulsions.

(*d*) Gastro-intestinal symptoms, such as abdominal discomfort, nausea, vomiting, distension, spastic constipation, diarrhœa, or colitis.

The foods that most commonly cause skin symptoms are fish, pork, strawberries, tomatoes, chocolate, cheese, milk, and cereals. Food allergies that may be present in asthma are specially related to eggs, milk, cheese, and butter; whilst in migraine the particular food to which persons may be allergic is wheat. Most of the symptoms are of short duration, seldom lasting more than an hour or two; and although the majority of allergies are related to food, a few may be due to inhalation of pollen, dusts, and other suspended matter, to injected substances, or to skin contacts. Cases have been known where kitchen workers developed skin rashes after peeling potatoes, onions, or other vegetables unless they peeled them under water. Heredity appears to play a part in skin allergy, for in about 50 per cent of cases one or both parents have been found to have an allergy to

certain foods. The special sensitivity is seldom inherited, the children having a tendency to allergic reactions to a different food or other substance.

In order to determine whether a food allergy is the cause of a given set of symptoms, an investigation into the dietary habits of the patient is first made and their possible relation to the symptoms is considered. It is often helpful to inquire if the patient has a particular dislike of a certain food, or finds that it disagrees with him. Then skin tests may be carried out, the suspected substances being rubbed into the skin through small abrasions or scratches, or injected into the skin. These tests are somewhat tedious and their results are not always conclusive. A third line of investigation is by giving test diets. These may consist at first of only a few foods of a kind that seldom give rise to allergy, and then adding other foods one at a time until the allergic symptoms appear; or an opposite procedure may be adopted, suspected foods being omitted one at a time from a diet until the offending article is identified. During these tests care must be taken that nutrition does not suffer as a result of taking an ill-balanced diet. Final conclusions are based upon the disappearance of symptoms when a certain food is withdrawn from the dietary and their reappearance when it is again included.

Having discovered the offending food the simplest course is to omit it from the diet altogether, and when the allergy is due to a non-essential food, such as mushrooms, shellfish, or strawberries, its omission does not give rise to special difficulties. But when foods such as milk, eggs, or wheat are involved the problem of finding satisfactory substitutes is not an easy one and it is very difficult to avoid small amounts of them, especially in commercially prepared foods; and they may be almost indispensable for efficient health and growth and for weight maintenance. It is then better to try to desensitize the patient. The process may take weeks or even months, and it may, after all, not be entirely successful. The process is as follows: The food in question must be completely omitted for several months, and it is during this time that it is important to arrange a diet that will be adequate for all the patient's needs. After this period—the symptoms having completely disappeared—the irritating food is first given in minute but frequently repeated doses. For example, one drop of diluted milk might be given several times a day, the dilution being decreased on subsequent days until one drop of whole

milk is given, and then the quantity is gradually increased. Or one drop of egg-white might be diluted with half a pint of water, and a teaspoonful of the solution given four-hourly at first, increased as the patient's tolerance improves. With such gradual desensitization whole milk or eggs can often be included in the diet after three to six months in a successful case, and thereafter there is complete freedom from the allergy.

SPECIAL DIFFICULTIES IN FOOD ALLERGIES IN CHILDREN

One of the skin diseases which is sometimes a manifestation of a food allergy in children is infantile eczema. It often commences before the baby is six months old. During the first year of life the diet is mainly milk, cereal, eggs, potato, some green vegetables, orange juice, and cod or halibut liver oil; the chief article of diet up to the age of six months being milk. So that if a food allergy is present it will in all probability be to milk, and this can be demonstrated by the scratch test. Even if the baby can be desensitized, a major problem is to find a suitable milk-free food for the period during which the desensitizing process is being carried out. Sometimes an evaporated milk which, after being reconstituted, has been boiled for twenty minutes, or fresh milk boiled in a double saucepan for several hours, can be tolerated when raw milk cannot. Goat's milk, either fresh or evaporated, may be found suitable, but if the allergy to milk is complete a synthetic milk-free food must be given. Milk substitutes made from soya bean are available, and these supply the necessary protein. Cornflour and oatmeal can be added, and so also can grated carrot and mashed legumes or banana. Orange juice and cod or halibut liver oil will supply the necessary vitamins C, A, and D.

Recently, amino-acid mixtures have been made by digesting proteins in the laboratory in such a way that all the essential amino-acids are preserved. These mixtures can be used instead of whole protein in the treatment of allergic conditions, and especially of milk-allergy in infants. The preparations have a somewhat disagreeable taste and odour, but the addition of dextrose and various fruit juices render them comparatively palatable

It has been found that with very careful feeding a milk or an egg allergy can often be completely overcome, with a dramatic recovery from the skin condition which is not followed by a recurrence in

later life; but, unhappily, many cases of infantile eczema do not appear to be influenced by any adjustment of diet.

If the possibility of a food allergy is not investigated until babyhood is passed, the approach is a little more difficult, for a mixed diet is then being taken and the child is not so completely under control, for he has developed likes and dislikes with regard to his food. It may be necessary to start treatment by eliminating milk, eggs, and wheat. Rye, rice, or soya flour can be used for making bread, and also for dredging fish or meat prior to cooking it. For the older child, cakes or muffins can be made with oatmeal and rice flour, or with soya flour and potato. Special care is needed to avoid the introduction of either milk or egg in cooking. For example, some baking powders contain egg, and pastry is often brushed over with milk and egg before it is put into the oven. Quite obviously, the arrangement of a diet that completely excludes milk, egg, and wheat requires a great deal of time, thought, and trouble; but if a child can be freed from the disability of an allergic skin eruption or other condition the parents are well repaid for the meticulous care that is needed in controlling his diet for a few months. It may be that even separate cooking utensils, dishes, knives, forks, and spoons will be needed; for all possible contact with the food to be excluded from the dietary must be avoided. The asthma of childhood may often be due to the same type of allergy as that responsible for skin conditions and should be investigated on the same lines. It must, however, be emphasized that only certain cases of infantile eczema or of asthma are due to a controllable food allergy.

CHAPTER 24

DIET IN SURGICAL CONDITIONS

From the point of view of their dietary treatment surgical cases can be considered in two main groups: those in whom the surgical procedures involve the alimentary tract and those in whom no interference with this tract occurs; but there are many general considerations that apply equally to both groups. The nutrition of a patient before and after a surgical operation has an important bearing upon his comfort, his period of disability, the progress of healing in his wound, and upon his liability to post-operative complications.

Patients may have been limited in their ingestion of food prior to the operation because of pain or vomiting, or a gastro-intestinal condition may have interfered with digestion and absorption of food; whilst others may be in a poor nutritional state owing to economic factors or to food fads and inhibitions. Normal feeding is interrupted on the day of operation and for several days afterwards and, whilst in an adequately nourished person a few days of semi-starvation is of little consequence, in a person who is already in a state of malnutrition the disturbance of the physiological functions involved may have serious results. The chief deficiencies that influence the progress of the surgical patient are of protein, vitamins, water, and mineral salts.

HYPOPROTEINÆMIA

This may result in delayed wound healing, the failure of fractures to unite, visceral œdema particularly affecting the lungs and the gastro-intestinal tract, and a reduced resistance to infection; for not only are proteins required for tissue building and repair but they supply the necessary amino-acids for the production of hormones, enzymes, antigens, and antibodies. The role of protein in facilitating bony union is dependent upon two processes—its utilization in the

fibroblastic repair that precedes callus formation and the fact that at least half of the serum calcium is bound up with serum protein.

The usual method of ascertaining whether or no hypoproteinæmia is present is to estimate the serum protein level. This is a reliable guide in conditions of malnutrition and in chronic diseases, but is misleading in the acute hypoproteinæmia that develops after extensive burns, severe hæmorrhage, intestinal obstruction, or paralytic ileus.

Chronic hypoproteinæmia must be overcome by increasing the dietary intake of protein unless the patient is unable to ingest, digest, or absorb a sufficient amount of food to correct the condition; in which case protein must be given parenterally. In acute hypoproteinæmia the administration of larger amounts of plasma is found to be effective in cases of burns, intestinal obstruction, and paralytic ileus, but the hypoproteinæmia that follows a severe hæmorrhage is treated by transfusion of whole blood. Recently, preparations of pure, crystalline amino-acids, dissolved into a clear solution and sterilized, have been given by the intravenous route, but this is a very expensive form of treatment and it seems unlikely that, even with improvements in the methods of manufacture, the cost could be reduced to a level that would make its use a practical possibility. Amino-acid mixtures can, however, be prepared by digesting proteins in such a way as to preserve all the amino-acids, and these mixtures have been found suitable for intravenous injection, for oral administration, and for gastrostomy and jejunostomy feeding; and their cost is relatively low. Apart from the treatment of surgical conditions, these amino-acid mixtures have been used in various allergic states, particularly in the milk allergy of infants. They have an unpleasant odour and taste, but these may be masked by the addition of dextrose and fruit juices.

VITAMIN DEFICIENCIES

These are usually subclinical; that is to say, they are not severe enough to produce any of the symptoms associated with the diseases that result from avitaminosis.

The deficiencies may be due to inadequate intake, inadequate absorption, increased requirements, or increased excretion. An in-

adequate intake occurs as a result of ignorance of food values, poverty, anorexia, restricted diets such as those for obesity, peptic ulcer, or diabetes mellitis, a large proportion of refined cereal or sugar in the diet, and chronic alcoholism.

Inadequate absorption may be due to persistent vomiting, repeated or continuous aspiration of stomach contents, lack of bile or pancreatic enzymes, liver damage, post-operative short-circuited gastro-intestinal tract, or intestinal conditions such as ulcerative colitis and sprue. Increased requirements may be dependent upon pregnancy, rapid growth, hyperthyroidism, long-established fever or infection, or increased intake of carbohydrates and alcohol.

An increased excretion may be due to lactation or to any condition resulting in polyuria, such as diabetes insipidus, untreated diabetes mellitis, or excessive fluid intake over a long period.

If any of these causes are known to be present, and the proposed operation is an extensive one or the post-operative intake or absorption is likely to be inadequate, the patient may be given large doses of vitamins for several days before operation. With the possible exception of vitamin D, all the vitamins are non-toxic and no harm can follow overdosage; so that as the present methods of determining the degree of deficiency are very complicated, the following prophylactic doses have been recommended for daily administration during the week previous to operation:

Vitamin A	3·3	milligrammes	or	10,000	International Units
Aneurin or thiamin (B_1)	5	,,	,,	1,666	,, ,,
Riboflavin (B_2)	6	,,	,,	2,400	Sherman-Bourguin Units
Nicotinic acid	50	,,			
Ascorbic acid (vitamin C)	100	,,	,,	2,000	International Units
Calciferol (vitamin D)	0·009	,,	,,	400	,, ,,
Vitamin K	2	,,			

Most of these can be given as tablets or as capsules, but aneurin, riboflavin, and nicotinic acid may be given as brewers' yeast or crude liver extract. If patients are unable to take food or medication by mouth the suggested amounts of aneurin, nicotinic acid, and ascorbic acid may be given parenterally, and so also may liver extract.

DEFICIENCIES OF WATER AND MINERAL SALTS

In pyrexia and in hyperthyroidism additional amounts of fluid are lost to the body by vaporization from the skin, the amount varying from 30 to 60 ounces daily above the normal fluid loss by this channel. To a certain extent this loss is compensated for in pyrexia, but not in hyperthyroidism, by a lowered kidney excretion and often by a decreased loss of fluid from the bowel. Vomiting and diarrhœa often result in a serious loss of both water and salts from the body. In surgical conditions continuous gastric suction-siphonage, by a Wangensteen or similar apparatus, and drainage from a biliary fistula result in fluid and salt loss. Any accidental injury that involves a large area of skin, such as extensive burns or lacerations, leads to serious depletion of body fluids, especially when such injuries occur after a period of strenuous physical exercise during which the loss of fluid by the skin had been greater than usual.

Any marked loss of fluid or salts from the body leads to an alteration in the acid/base equilibrium, and therein lies its greatest danger. The signs of dehydration are clear and unmistakable. They include a sunken facial expression, dryness and loss of elasticity of the skin, thirst and dryness of the tongue and mouth, and diminished urinary excretion; followed later by a marked lethargy and muscular twitching. The treatment consists of replacement of fluid and salts by the oral, rectal, subcutaneous, or intravenous routes, caution being necessary in patients with cardiac involvement, in elderly persons, and those with a low serum protein level. In these patients plasma transfusions are often given instead of salt solutions. An excessive administration of fluid and sodium chloride may lead to œdema in any person.

The fluid given should be isotonic with the blood. Such fluids include normal, or physiologic, saline, 5 per cent glucose solution, Ringer's solution, and Hartmann's solution. It should be remembered that normal saline *with* 5 per cent glucose is hypertonic and should not be given unless specially ordered. Usually, equal parts of normal saline and 5 per cent aqueous solution of glucose are given, and if no food is being taken by mouth it is important that aneurin hydrochloride (vitamin B_1) is added to the glucose solution in adequate amounts. Ringer's solution contains sodium chloride, calcium, and potassium. Hartmann's solution is similar, but it

contains sodium lactate in addition to the salts that are present in Ringer's solution.

The fluids given by the rectal route are tap water and normal saline. The practice of giving glucose saline per rectum is seldom followed nowadays as it has been shown that glucose is not well absorbed by the large intestine.

GENERAL PRE-OPERATIVE FEEDING

Where no special diet is indicated because of the disease itself or the nature of the proposed operation, the patient should be given ample protein, carbohydrate, and vitamins during the week before the operation is to take place. The diet should supply 2,500 Calories and should be bland and easily digested. The last meal before the operation, which should be a very light one, should be given at least six hours before the time fixed for the operation, after which nothing should be given by mouth; so that the stomach will be empty by the time the anæsthetic is given. The chief danger of food in the stomach is from vomiting, choking, cyanosis, and the possible inhalation of vomitus during anæsthesia or when recovering from its effects; and food retained in the stomach during anæsthesia increases the possibility of post-operative vomiting, gastric dilatation, and gaseous distention of the intestines. If the operation is on the stomach itself or the small intestine, it is rendered more hazardous by the presence of food in these organs. In preparing a patient for an emergency operation the stomach contents may be aspirated through a tube.

Gastro-intestinal surgery is usually preceded by rather exhausting examinations and tests which involve periods of starvation, the introduction of somewhat toxic agents into the body, the intensive use of X-rays, and some degree of physical and mental strain in a patient already debilitated by defective alimentary functions; so that after the necessary diagnostic procedures have been concluded the patient should, if possible, be allowed some time to recuperate before the operation is performed. During this period his nutritional state should be improved as far as is possible. Gastric lavage may be ordered on the day before operation and repeated shortly before the patient goes to the operating theatre.

POST-OPERATIVE FEEDING

Most patients suffer from nausea after recovering from the unconsciousness produced by a general anæsthetic, and there is usually some degree of vomiting, especially of bile-stained fluid that has regurgitated through the relaxed pyloric sphincter into the stomach; so that not only is there no desire for food but it would be unwise to give it. Even after spinal anæsthesia there may be nausea and vomiting; and when the operation is an abdominal one, and especially if it has involved opening into the gastro-intestinal tract, the question of suitable nourishment has an added importance.

A general anæsthetic, being absorbed into the circulation, will affect all structures, and not only those of the central nervous system; so that an inhibition of peristalsis is by no means rare in the immediate post-operative period, and this may progress to a condition of paralytic ileus, even when the operation has not involved abdominal structures.

In a patient whose nutritional state prior to the operation was quite satisfactory, no harm follows a day or two of abstinence from solid food; and after operations that do not affect the alimentary canal refreshing and nourishing fluids may be taken, if desired, within a few hours of recovering consciousness. Indeed, a soft diet may be allowed, if the patient desires it and there is no nausea or vomiting; but usually the following post-operative régime is adopted: Sips of water are given as soon after recovery from unconsciousness as the patient wishes. After six to eight hours, tea, coffee, fruit juice, and clear broth may be given; but milk and fluids containing large amounts of carbohydrate, such as sweetened fruit drinks, are best avoided if there is any tendency to gaseous distension of the intestines. Some surgeons prefer that nothing should be given by mouth until active peristalsis can be heard through a stethoscope applied to the abdominal wall. On the second evening a mild aperient may be given or a simple enema may be ordered for the following morning, unless these measures are contra-indicated owing to inflammatory lesions or bowel surgery. An evacuation of the bowels helps the elimination of anæsthetic products, and after this the patient is usually ready to take solid food.

In an uncomplicated case the following foods are suitable for inclusion in the diet given on the third day after operation:

All fine cereals, milk, with or without cream, malted milk, Ovaltine, tea, coffee, or cocoa.

Soft-boiled, poached, or scrambled eggs. Omelets.

Broths, cream soups, tomato soup.

Boiled, mashed, or baked potatoes. Puréed vegetables, rice, macaroni, or spaghetti.

Baked or steamed white fish, chicken, rabbit, sweetbread, or very tender broiled beef or mutton.

Jellies, junket, custard, ice cream, milk puddings, baked apple with skin and core removed, tinned peaches, pears, apricots, or pineapple, prunes if skin is removed.

Bread, butter, and cheese as desired.

Salt is allowed in moderation. Foods to avoid are pepper, mustard, vinegar, sauces, and highly seasoned food. Bran, coarse-fibred vegetables, very new bread, pastries, and fried foods are unsuitable and may lead to abdominal discomfort and distension, or cause a renewal of the vomiting.

CONDITIONS REQUIRING SPECIAL DIETARY MODIFICATIONS

OPERATIONS ON THE BILIARY TRACT

The difficulty here is twofold. In the first instance the patient has probably had some degree of jaundice and the presence of bile in the blood hinders coagulation whilst its absence from the intestinal tract interferes with fat digestion and predisposes to an inhibition of peristalsis. Secondly, the probable depletion of glycogen stores renders the liver cells vulnerable to further damage both by the anæsthetic and by the operative procedures.

Unless an acute cholecystitis or an acute obstruction of the common bile duct is present, the pre-operative treatment includes the giving of a high carbohydrate diet, with ample protein but restricted fat. Vitamin K and bile salts are administered in order to stimulate the formation of prothrombin, and the patient may also be given calcium lactate. Ravdin's diet for liver conditions is one that contains 555 grammes of carbohydrate, 164 grammes of protein, and 14 grammes of fat. It provides approximately 3,078 Calories.

RAVDIN'S HIGH-PROTEIN, HIGH-CARBOHYDRATE, LOW-FAT DIET

Food	*Amount*	*Protein gm.*	*Fat gm.*	*Carbo-hydrate gm.*	
Breakfast					
Fruit juice	200 gm. or 7 oz.	2	0·2	20	
Sugar	10 gm. or 2 teaspoons	—	—	10	
Cereal	150 gm. or 4½ tablespoons	4	—	18	
Egg white	one	4	—	—	
Sugar	10 gm. or 2 teaspoons	—	—	10	
Bread or toast	60 gm. or 2 slices	6	—	30	
Skimmed milk	240 gm. or 8½ oz.	8	2	12	
Jelly	20 gm. or 1 tablespoon	1	—	15	
Fruit	150 gm. or 4½ tablespoons	1	—	15	
	Total	26	2·2	130	= 660 Calories
Mid-morning					
Skimmed milk	180 gm. or 6 oz.	6	1	9	
Banana	100 gm. or 1 banana	2	—	20	
Casec	5 gm. or 1 teaspoon	4	—	—	
Sugar	5 gm. or 1 teaspoon	—	—	5	
Cream crackers	Two	2	—	12	
	Total	14	1	46	= 255 Calories
Midday					
*Low-fat meat or fish	60 gm. or 2 oz.	11·3	1·6	0·8	
**Vegetables 5%	100 gm. or 3 oz.	1	—	3	
,, 10%	100 gm. or 3 oz.	1	—	6	
,, 20%	150 gm. or 4½ oz.	3	—	30	
Bread	60 gm. or 2 slices	6	—	30	
Fruit juice	200 gm. or 7 oz.	2	0·2	20	
Egg white	One	4	—	—	
Sugar	10 gm. or 2 teaspoons	—	—	10	
Fruit	150 gm. or 4½ tablespoons	1	—	15	
Skimmed milk	240 gm. or 8½ oz.	8	2	12	
Jelly	20 gm. or 1 tablespoon	1	—	15	
	Total	38·3	3·8	141·8	= 773 Calories

Food	*Amount*	*Protein* *gm.*	*Fat* *gm.*	*Carbo-hydrate* *gm.*	
3 *p.m.*					
As mid-morning		14	1	46	= 255 Calories
Evening meal					
Low-fat meat or fish	60 gm. or 2 oz.	11·3	1·6	0·8	
Vegetable—as midday		5	—	39	
Other foods—as midday		22	2·2	102	
Cheese	100 gm. or 3 oz.	20	1	4	
	Total	58·3	4·8	145·8	= 880 Calories
At bedtime					
As mid-morning		14	1	46	= 255 Calories

Total Calories = 3,078

* The food values as given in the above table are the average if the following are used in rotation—broiled beef with all visible fat removed, liver, breast of chicken, steamed cod, plaice or sole, or oysters.

** 5% vegetables include—tomatoes, watercress, radishes, leeks, broccoli, French artichokes, and young runner beans.

10% vegetables include—runner beans, brussels sprouts, turnip, onions, beetroot, carrots, and young green peas.

15% vegetables include—green peas, Jerusalem artichokes, and parsnips.

20% vegetables include—potatoes, baked beans, boiled rice, and macaroni.

In acute cholecystitis or acute obstruction of the common bile duct, nausea and vomiting are often marked symptoms. They can be relieved only by ceasing to give any fluids or foods by mouth; for gastric and duodenal stimulation by food tends to prolong the acute stage. Fluids and salt are given by subcutaneous or intravenous injection. If vomiting is not thereby controlled gastric lavage may give relief, or continuous suction-drainage may be instituted. After twenty-four to forty-eight hours the acute symptoms will probably have subsided, and then 2 to 3 ounces of fluid, such as water, tea without milk, or with skimmed milk, or clear fatless broth, may be given hourly, and as tolerance for food increases, bread, toast, white fish, breast of chicken, and plain mashed potato may be added to the diet gradually, the quantities may be increased and other foods added until the diet approximates to the Ravdin diet.

The same general principles are adopted with regard to the diet in the post-operative period, the most important point being the limitation of fat until bile is again flowing freely into the duodenum.

SURGICAL CONDITIONS OF THE GASTRO-INTESTINAL TRACT

Following operations on the gastro-intestinal tract more harm can be done by the early ingestion of liquid and solid food than by abstinence, for food stimulates painful peristaltic activity and often increases nausea and vomiting. Milk may be particularly undesirable, for it is apt to coagulate into large curds which in the intestine gives rise to the formation of gases that cause distressing tympanites and are but slowly absorbed.

The post-operative feeding after gastro-enterostomy and partial gastrectomy is to a certain extent an individual matter, depending upon the condition of the patient and the particular views of the surgeon. As a general rule, only parenteral feeding is allowed for the first twenty-four hours and the stomach may be kept in an empty and collapsed condition by means of a tube passed through the nostril and connected with a suction apparatus. Alternatively, the tube can be attached to the cheek by a piece of adhesive tape, and every hour the gastric fluids are aspirated by means of a 20 cubic centimetre syringe. After the first twelve hours the patient may be allowed to drink a few drachms of water every fifteen minutes provided that this is immediately aspirated through the tube. If no complications appear imminent and there is every reason to believe that the anastomosis is holding well, the tube is removed after twenty-four hours and thereafter oral feeding may be given as follows:

Second day—Half an ounce of fluid half-hourly, suitable fluids being soda water, light ginger ale, tea with sugar but no milk, barley water.

Third day—The feeds are increased to 1 ounce but are given hourly, and are varied by the inclusion of calf's foot jelly, junket, and albumen water flavoured with orange or lemon juice.

Fourth day—The quantity is increased to 2 ounces but the interval is lengthened to two hours malted milk made with water may be added.

Fifth day—Four-ounce feeds are given two-hourly, the additional

foods allowed being lightly poached egg, egg soufflé, clear soup, toast, and custards.

Sixth day—The same as the previous day.

Seventh day—Six small meals are given daily, using much the same foods as before.

Eighth day—As on the seventh day.

Ninth day—The suture line should now be completely healed and a more varied diet can be given; but meals must be small and frequent and all food must be eaten slowly and must be well masticated.

Suitable foods to include are fresh orange juice, tomato juice, baked or boiled apple without skin or core, broiled or roast tender beef, lamb, chicken, liver, or sweetbread, puréed vegetables, baked or mashed potato, sponge cake, ice cream, milk, chocolate, and coffee. Alternatively, the Meulengracht diet suggested for the second day after a hæmatemesis may be given.

DIET IN FISTULA OF THE SMALL INTESTINE

Careful planning of meals is important and it should aim at reducing the fistula drainage to a minimum. To this end, foods that are digested and absorbed mainly in the upper part of the intestinal tract are given. These include light cereals, creamed soups, creamed fish, minced white meats, eggs, and white bread if obtainable. Puréed vegetables and fruits are allowed, but those with a high cellulose content are forbidden. Small meals should be taken at frequent intervals and fluids should be taken between meals rather than with them. It may be necessary to supplement the dietary fluids by subcutaneous or intravenous administration for a few days.

DIET AFTER COLOSTOMY

For the first few days, low-residue liquids and semi-solids are the only foods allowed, but after the loop of bowel is opened—which is usually on the fifth day—a soft diet is given. This should be of a low-residue type but, unlike the diet recommended for fistula of the small bowel, the meals should be well spaced, only three being allowed each day. No food should be taken between meals. It is important that the action of the colostomy should be controlled, so that foods that stimulate peristalsis unduly should be avoided. A typical low-residue

diet suitable for the first week after a colostomy is opened could include: fine cereals with boiled milk, boiled eggs, dry toast, milk with sugar if desired, tea and coffee in moderation, cream soup, white fish, tender meat such as chicken, lamb, scraped beef, or minced liver, baked or mashed potato, cooked fruits, and vegetables which must be strained or puréed, bananas, custards, well-cooked rice, macaroni, or spaghetti, cream cheese, honey, and jellies.

When the colostomy is acting regularly and is under control, a more extensive diet is allowed, adding slowly, one at a time, the foods containing cellulose; but if the bowel movements become loose the last food to be added must be taken out of the diet. In time the patient learns how to arrange his diet so that the fæcal discharge is almost limited to one action a day.

FEEDING AFTER GASTROSTOMY

Practically the only condition for which gastrostomy is performed is the presence of an œsophageal obstruction that prevents the swallowing of food, and therefore the operation usually takes place at a time when the patient's general condition is already impaired by restricted food intake. Thus it is important that feeding should commence as soon as possible, and many surgeons give the first feed through the gastrostomy tube directly the operation is completed and before the patient leaves the theatre. The feed usually consists of about 5 ounces of warm peptonized milk. Other surgeons prefer to keep the stomach at rest for twenty-four hours and to give fluids by rectal or intravenous injection.

The fistula into the stomach is usually made in such a way that a valve-like action will later prevent any leakage of gastric contents. A tube about twelve to fourteen inches long is inserted into the stomach, and it is clamped near its distal end except when a feed is actually to be given, when the clamp is removed and a glass funnel is attached. It may at first be necessary to give only small feeds because the capacity of the stomach is often reduced owing to the inadequate amounts of food that the patient had been able to swallow for some time previous to operation.

If possible, 5-ounce feeds should be given two-hourly from 7 a.m. till 9 p.m.; which will make a total of two pints a day, but this quantity is gradually increased to 10 ounces two-hourly as the

stomach becomes accustomed to larger feeds. A suitable mixture for the first day would be 32 ounces of milk, 4 ounces of cream, 1 ounce of sugar, and 4 eggs. This is beaten up together and strained. It will provide about 1,314 Calories. When the feeds have been increased to 10 ounces each the total Calorie intake is 2,628. The juice of one or two oranges or tomato juice is added to supply vitamin C, brewer's yeast or Marmite to supply the vitamins in the B complex, and cod or halibut liver oil to supply vitamins A and D. It may also be necessary to add some preparation of medicinal iron, especially if the patient has any degree of anæmia.

Seeing that the patient cannot swallow food he is denied the pleasurable anticipation of meals and the interest and enjoyment of eating; and thus he loses the stimulus to the secretion of digestive enzymes that follows upon these emotions. Much can be done to minimize this loss by preparing the feeds on a dainty food-tray instead of on a dressings-tray. The patient may wash out his mouth with any drink he desires, such as tea, coffee, lemonade, fruit juice, ginger ale, or a mild alcoholic beverage; and ordinary foods may be masticated even if they cannot be swallowed. Later, well-masticated foods may be expectorated into the funnel and be washed into the stomach by the prepared feed; and as this food is thoroughly mixed with saliva the action of ptyalin on starch digestion is not lost.

In the actual giving of the feeds, and also in dressing the wound, great care must be taken not to displace the tube until a definite tract has formed, which is usually by the end of a week. Thereafter the tube can be taken out daily and be cleansed and replaced. After about a month the tube may be left out at night, the opening being covered with a gauze dressing; but if the opening tends to contract a special gastrostomy plug must be worn when the tube is not in position.

Before running in any of a prepared feed a little sterile water should be poured into the funnel. If the tube *has* slipped out of the stomach into the peritoneal cavity the patient will experience a sudden, acute pain as the water runs in, but this is of short duration and no damage is done; whereas the feed itself might set up a peritonitis. Having ascertained that the tube is in the correct position the whole of the feed is given, after which a little more sterile water is run in to clear the tube before again clamping it, or reinserting a spigot.

Soft solids such as puréed fruits or vegetables and minced fish or

meat can be given through the tube by means of a syringe resembling a grease gun, and this, together with the food masticated by the patient, makes it possible for all the constituents of a normal diet to be taken. Eventually the patient learns how to insert and remove the tube, how to cleanse it, and how to care for the skin around the fistula. He learns the method of preparing and giving the feeds, the most suitable foods to use, and the quantities needed.

JEJUNOSTOMY TUBE FEEDING

Occasionally after a partial gastrectomy and practically always after a complete gastrectomy the patient may be fed through a small tube inserted through a stab wound through the abdominal wall into the jejunum. The distal end of the tube may be left unclamped during the first twenty-four hours in order that accumulated fluids or gas may escape, and a gastric or duodenal tube is inserted through the nostril or the mouth and fluids collecting in the upper gastro-intestinal tract are aspirated in the same way as after other gastric operations. Fluids are given by parenteral injection only, usually by continuous intravenous drip, during the first day. After this time, two-ounce feeds are given two-hourly through the jejunostomy tube, these feeds consisting of normal saline with 5 per cent glucose and $2\frac{1}{2}$ per cent amino-acids. On the fourth day, if the patient's progress is satisfactory, these feeds may be alternated with feeds of pancreatized milk, beef juice, white of egg, and dextrose, the same precautions being taken as with gastrostomy feeding. If any significant quantity of upper gastro-intestinal secretion is aspirated through the tube leading from the nostril or mouth into the duodenum it can be placed in the jejunal feed, and any medicaments—such as aspirin, codeine, or a barbiturate—that may be ordered are given through the jejunostomy tube. On the fifth day the parenteral fluids are discontinued and clear fluids may be given by mouth in small quantities of one teaspoonful every hour, the jejunostomy feeding being continued. The oral feeds are increased as the interval between them is lengthened, in the same way as with other gastric cases, until by the eighth day four to five ounces are given every two or three hours, and the jejunostomy tube is then removed. Thereafter the diet is gradually built up until full nutriment is taken by mouth.

Jejunostomy feeding may be given by the continuous drip method.

The suggested formula for preparing the feed is to beat one egg with a pint of milk and then to peptonize the mixture, afterwards adding 6 milligrammes of aneurin, 15 cubic centimetres of vitamin B complex syrup, 300 milligrammes of ascorbic acid, and 3 drops of halibut liver oil. This yields about 480 Calories. The feed is kept in the refrigerator until required, and from twelve to twenty-four hours after the patient returns from the theatre the jejunostomy feeding is commenced. About half of the mixture is put into the flask at a time and the drip is regulated so that 50 cubic centimetres is introduced hourly until the jejunum becomes accustomed to the feeds. Gradually the rate of flow is increased, and by the third day three to five pints may be given in the twenty-four hours. If the feed is given too quickly the patient may complain of nausea and there may be vomiting and diarrhœa. Another cause of these symptoms is the presence of fat in the feeds, and if this is thought to be the case skimmed milk is substituted for whole milk.

If the jejunostomy is to be a permanent one, the tube is left in until the twelfth or fourteenth day, so that the fistula will be definitely formed, and thereafter the same general principles apply as with duodenal feeding. The food needs to be peptonized or pancreatized, and preparations of amino-acids are valuable additions to the feeds.

CHAPTER 25

AN INTRODUCTION TO SICKROOM COOKERY

The cooking of food serves to make it more digestible, more palatable, and more attractive. It also destroys bacteria. The cellulose fibres in cereals, fruits, and vegetables are softened, starch granules are ruptured, and the fibres of meat are converted into a gelatinous substance. Flavour is developed and is augmented by the addition of salt, pepper, and other condiments, herbs, spices, sugar, and flavouring essences. But the nutrient value of food is often impaired, especially in regard to its vitamin content and to a lesser degree in regard to minerals; and a loss of soluble constituents is almost inevitable.

The effect of heat upon the proteins of food is to coagulate them, and this change begins at a temperature of about 140° F. At higher temperatures there is a shrinkage of the protein in animal foods, which causes a slight decrease in digestibility. Egg and fish roe protein does not shrink with heat, thus proving an exception to the general rule.

Carbohydrates undergo considerable change with cooking. Dry heat renders starch more soluble and finally converts it into dextrin; as is seen in the crust of bread, the outside of pastry, and in toast. Moist heat causes starch granules to swell until their enclosing envelopes are ruptured and gelatinization occurs, which greatly increases digestibility. The acids of fruits when heated with sugar brings about an hydrolysis of the sugar, and in non-acid foods the sugar may be changed into caramel.

Fats are less affected by heat than are either proteins or carbohydrates, but when one of the dry methods of cooking is employed some of the fat may be split into fatty acids which have an irritating effect upon the gastric mucosa.

COMMON METHODS OF COOKING

(1) *Baking*. This is cooking in an oven, the heat affecting all parts of the food at once. The effect of baking upon meat is that shrinkage occurs, causing some of the juices to be expressed; but as these evaporate upon the surface of the meat they are not lost. There is a greater concentration of mineral salts and more coagulation of protein on the outside of baked, roasted, or grilled foods than on the inside. A loss of weight occurs, but as this is nearly all due to evaporation it can be minimized by frequent basting.

(2) *Roasting*. The heat is conveyed to the food by direct radiation, so that it is applied only to one side of the food at a time. The effects upon the food are similar to those of baking.

(3) *Grilling*. The food to be cooked is placed upon a grid which is under the source of heat. The effects are the same as in roasting but the method is more applicable to small, thin pieces of fish or meat than to larger portions. The food needs to be turned at intervals so that both sides become equally cooked.

(4) *Frying*. This consists of the sudden exposure of the food to be cooked to a very high temperature and it can best be achieved by using some kind of oil or fat as the medium, for this boils at a temperature of 350° to 450° F. The fat should be heated in a deep pan and when it begins to give off a fine smoke the food should be plunged into it. The moisture on the surface of the food is suddenly converted into steam, causing spluttering which continues for a few minutes, after which time the food is sufficiently cooked; when it should be lifted on to a draining grid in order that excess fat can drain away. Food cooked in this way is not greasy, for the fat does not penetrate. If, however, the fat is insufficiently heated before the food is put into it the food will absorb fat. To prevent this it may be coated with a paste made of flour and milk or with egg and bread-crumbs. As the chemical digestion of fat does not take place until it reaches the small intestine, foods that are coated with fat miss a good deal of the gastric phase of digestion; for the enzymes cannot reach them until they are freed from fat. Many people regard frying as a process whereby only sufficient fat is used to prevent the food sticking to the pan and becoming burnt. Such a method results in roasting rather than frying, and it is correctly known as *sautéing*.

(5) *Braising*. This method is used especially for meat but some

vegetables are usually added. The proteins on the outside of the meat are coagulated by sautéing, which prevents the escape of juices, and it is then placed in a covered pan, often with vegetables and stock, and is cooked in the oven. Much less evaporation takes place than with baking, even when no water or stock is added, so that the meat shrinks less and is more moist than either baked or roast meat.

(6) *Boiling, stewing, and simmering*. With all three of these methods the food is cooked in a pan of water, the heat being applied at the bottom. With boiling, the temperature of the water is maintained at 212° F. and constant bubbling occurs. Soluble mineral salts pass into the water, proteins are hardened, flavouring ingredients are lost, vitamin C is destroyed, and vitamins A and B_1 are impaired. With stewing, correctly performed, and with simmering the temperature of the water is below boiling point, usually between 180° and 190° F. This coagulates without hardening the proteins, the flavour is preserved, and the prolonged action of the heat and moisture converts most of the connective tissue of meat into gelatin and softens the cellulose of vegetables and fruits. When meat is to be cooked by these methods it should first be plunged into boiling water and kept at this temperature for about five minutes in order that sufficient coagulation of proteins shall occur at once and so form a coating which prevents the juices from escaping. If broth or soup is to be made the meat should be cut into small pieces and be put into cold water which is slowly brought to the boil. In this way the maximum amount of juices and extractives pass into the water.

(7) *Steaming*. This is cooking over boiling water, either in a double saucepan or with the food resting upon a stand in the saucepan. Alternatively, the food may be placed in a basin and be covered with greased paper and a cloth, the boiling water reaching only to two-thirds the height of the basin. This is a suitable method for steamed puddings. With steaming, soluble substances are not lost in the cooking water and flavouring ingredients are preserved. The latter is particularly important when cooking fish by any moist method, for if it is immersed in the water, as in boiling, it becomes most unappetizing.

SUGGESTIONS FOR CONSERVING THE NUTRIENT VALUES OF FOODS

As little water as possible should be used and air should be excluded by keeping lids on saucepans whilst cooking. Foods should not be stirred more than is necessary during the process of cooking; and foods should not be warmed up if this can be avoided; for reheating further reduces the vitamins that have already been depleted by the cooking.

Conservation of vitamin A. Exposure to air and to oxygen is destructive of vitamin A, so that fruits and vegetables should not be stored for longer than is absolutely necessary. Vitamin A content is also reduced by dry packing of fruits and vegetables for long periods.

In preparing vegetables for cooking as much as possible should be used; for the green stalks of celery and asparagus are much richer in carotene than are the whiter parts, whilst the green outer leaves of cabbage and lettuce contain about ten times as much as the pale inner leaves. Frying is more destructive of both carotene and vitamin A than any other method of cooking, whilst steaming with exclusion of air is the least destructive. If the food is dropped into actually boiling water oxidizing enzymes are destroyed and dissolved oxygen is removed, and hence destruction of carotene, vitamin A, and vitamin C is minimized.

Conservation of vitamin B. Although frying is the most destructive method of cooking with regard to vitamins A and C, it causes less change in vitamin B_1 (aneurin or thiamin) than any other cooking method; but long baking or roasting of meats reduces their aneurin content; and in the stewing or simmering of both meats and vegetables a good deal of this vitamin passes out into the water; which should, therefore, be used for soups, gravies, or vegetable-juice cocktails, for in this way much of the aneurin loss is recovered. If soda is added to the water in which vegetables are cooked a good deal of their aneurin content is destroyed. Riboflavin and nicotinic acid are stable to most methods of cooking.

Conservation of vitamin C. This is the most unstable of the vitamins. Nevertheless, a good deal of it may be conserved by thoughtful preparation and cooking of food. When possible, foods containing vitamin C should be eaten raw, and after the shortest possible period of storage. The refrigeration of fruit and vegetable juices lessens

their vitamin C content; although orange, tomato, and grapefruit juices are apparently exceptions.

Vitamin C is destroyed by heat, oxidation, contact with air, shredding, chopping, or slicing. Salads should therefore be prepared shortly before being served, and excessive shredding, chopping, or slicing should be avoided. It has been shown that 40 to 50 per cent of vitamin C is lost in a few hours from a salad that has been elaborately prepared.

The vitamin C content of tomatoes appears to increase as the fruit matures and it survives cooking better than in other fruits and vegetables. In cabbage there is less vitamin C in the matured than in the young plant. The use of soda to preserve the green colour of vegetables whilst cooking is destructive of vitamin C as well as of aneurin.

The vitamin C content of potatoes is more stable than that of green vegetables. To conserve as much of it as possible, potatoes should be steamed in their skins. New potatoes cooked in this way are estimated to contain as much vitamin C as the citrus fruits if they are eaten immediately they are cooked. If the skins are removed prior to cooking about 10 per cent of their ascorbic acid is destroyed by steaming and about 20 per cent if they are baked or boiled; but a good deal more is lost if the potatoes are kept hot after cooking. If potatoes are to be mashed this should be done immediately before they are served, for experiments have shown that two-thirds of their vitamin C content is lost after 20 minutes and 90 per cent after 30 minutes from the time they were mashed.

BEVERAGES

In preparing any food or refreshment for sick people it is important that it should present an attractive appearance and that its temperature should be suitable. Clear drinks should be really clear; suspended particles being removed by straining the liquid through double muslin. If food is to be taken hot it must be served on hot plates, but a drink should not be so hot that the patient must wait whilst it cools, for such waiting dulls the edge of the subsequent enjoyment. For cold drinks, ice should be used when available, or the drink should be prepared and then be placed in a refrigerator until required. If this is not possible, the jug or container should be stood in a

shallow dish of water and be covered by muslin or a cloth that is large enough for the ends to dip into the water; for it is then kept wet by capillary attraction. The slow evaporation of the moisture cools the container and therefore the drink. Merely standing a container in water will cool its contents only to the temperature of the water, which in summer may be 70° to 80° F.

PREPARATION OF REFRESHING DRINKS

Apple Water.—1 apple, or the peel of 2 or 3 apples.

Flavouring, such as lemon, cloves, ginger, or cinnamon.

1 teaspoon of sugar, or 1 tablespoon of glucose.

Half-pint of water.

Cut up the apple with the peel and the core, and allow it to simmer in the water with the flavouring for half an hour. Then strain through double muslin, add the sugar or glucose, set it aside to become cold, and serve with crushed ice.

Barley Water (*thin*). 1 tablespoon of pearl barley.

1 teaspoon of sugar or 1 tablespoon of glucose.

Half a lemon, or other flavouring.

Half-pint of boiling water.

Wash the barley, put it in a lined saucepan with sufficient cold water to cover it, bring it quickly to the boil, strain it, and discard the water. This process is called 'blanching', for it whitens the barley so that the drink, when prepared, does not have a dark or cloudy appearance. Place the barley in a jug, add the sugar or glucose and the juice and pared rind of the lemon, or other flavouring. Pour the boiling water over it, cover the jug, and allow it to stand until cold, when the water is strained off and is served with crushed ice.

Blackcurrant Drink.—1 dessertspoon of blackcurrant jam, or purée.

A few drops of lemon juice, or a little thinly pared lemon rind.

Sugar to taste.

Half-pint of boiling water.

Put all the ingredients into a lined saucepan, bring to the boil and simmer for 2 or 3 minutes, then cover the saucepan and put it in a warm place—for example, on a stove—for 15 to 20 minutes. Strain and serve it hot.

Ginger Tea—Half-teaspoon of ground ginger.

1 tablespoon of golden syrup.

Half-pint of boiling water.

Mix the syrup and ginger together, add the water and boil the mixture for 2 minutes. Serve the drink hot.

Grapefruit Squash.—1 grapefruit.

1 dessertspoon of sugar or 2 tablespoons of glucose.

Half-pint of soda water, or cold water.

Squeeze as much juice as possible from the grapefruit, add the sugar or glucose, and stir it well, and then add the soda water and serve with crushed ice.

Imperial Drink.—1 teaspoon of cream of tartar.

Half a lemon.

1 dessertspoon of sugar or 2 tablespoons of glucose.

Half-pint of water.

Put the cream of tartar, the lemon juice, and the sugar in a jug. Pour on $\frac{1}{2}$ a pint of boiling water and when cold strain and serve with crushed ice.

Lemonade.—1 lemon.

1 dessertspoon of sugar or 2 tablespoons of glucose.

Half-pint of water.

Wipe the lemon and pare the rind thinly. Put the rind, the sugar, and the juice into a jug and pour the boiling water over it. Allow it to stand until cold, then strain and serve with chipped ice and a slice of lemon.

If the pared rind is simmered in a pint of water for 5 minutes and this is poured over the juice and the sugar, 1 pint of lemonade can be made from 1 lemon.

Orangeade.—An orange is substituted for the lemon and the drink is made in the same way as lemonade, but it is served with a slice of lemon rather than orange.

Prune Water.—2 oz. of prunes.

Half a lemon.

1 teaspoon of sugar or 1 tablespoon of glucose.

A few drops of cochineal.

Half-pint of water.

Soak the prunes until soft, and then stew them in half-pint of water with the pared rind of the lemon. Sieve the prunes and add the lemon juice, sugar, and cochineal. Stand until cold and, after straining, serve with crushed ice.

Raisin Tea.—This is made in the same way as prune water but

substituting 3 tablespoons of raisins for the prunes. The raisins are not soaked but are stewed for half an hour.

Toast Water.—1 slice of stale bread, preferably crust.

1 pint of cold water.

A little lemon juice or other flavouring if desired.

Toast the bread on both sides without burning it. Put the cold water into a jug and break the toast into small pieces and put them into the water. Cover the jug and allow it to stand until the water is the colour of sherry. Then strain and serve the drink cold, with lemon juice, port wine, or other flavouring. If the water is poured over the toast it would become cloudy and so appear less appetizing.

PREPARATION OF STIMULATING DRINKS

The addition of port wine or sherry to any of the refreshing drinks gives them a stimulating character. Among other stimulating drinks are beef tea, coffee, and tea.

Beef Tea (1*st method*).—½ lb. of lean, juicy beef.

A pinch of salt.

Half-pint of water.

Remove any fat or skin from the meat, cut it into thin slices, and then shred it finely in order to break the fibres and allow the juices to escape more easily. Alternatively, the beef may be put through a mincing machine. Then put it to soak in the cold water and allow it to stand for 2 hours, squeezing and pressing the meat frequently. Stand the container in a saucepan with water reaching to a level of about two-thirds of the sides and heat it gently until the beef tea is a reddish brown. Strain it through a fine wire sieve, pressing the meat as dry as possible. Add salt, if allowed, and serve at once.

If raw beef tea is ordered, the cooking is omitted and the tea is strained after standing for 2 hours. It should be served cold in a coloured glass. Red wine is sometimes added.

Beef Tea (2*nd method*).—The same ingredients are used as for the first method. The meat is prepared in the same way and if time permits it may be soaked in the water for half an hour. It is then placed in a lined saucepan and is simmered gently at a temperature not exceeding 150° F. for 15 minutes. The beef will then be pale in colour and the liquid a rich brown. It is strained and served as with the first method.

Bovril, Oxo, and other beef preparations have largely replaced home-made beef tea. They are slightly stimulating but have very little nutritive value.

Coffee.—Use 1 tablespoonful of coffee to each half-pint of water. Coffee can be made in a percolator or in a jug. If the latter, the jug is warmed and the required amount of coffee is put into it, together with a pinch of salt, and the boiling water is poured over the coffee. It is stirred and stood in a warm place for 10 minutes, after which it is stirred a second time and is allowed to stand for a further 5 minutes in order that the grounds may settle. Then it may be served either black or with scalded milk and sugar to taste.

Tea.—To obtain the maximum stimulation from tea it must be made with freshly boiled water which should never be drawn from a hot tap or a kitchen boiler. The teapot must be heated by half-filling it with boiling water, which is then poured away, the tea is put in and boiling water is immediately poured over it. The lid is replaced and the teapot is covered with a cosy or is stood in a warm place for 3 to 5 minutes. This will suffice to extract the theine, which is the stimulating ingredient in tea. Longer standing will extract tannin, which gives the tea a bitter taste and may irritate the gastric mucosa and harden the proteins taken in foods. If it is necessary to keep the tea hot for any length of time the leaves should be removed from it after 5 minutes. Some teapots are fitted with an inner perforated case which contains the leaves and which can be lifted out when the tea is sufficiently infused.

PREPARATION OF NOURISHING DRINKS

Milk Tea.—1 teaspoon of tea, China tea preferred.

Half-pint of milk.

The tea is made with boiling milk instead of water. It is allowed to stand for 10 to 20 minutes. The casein of the milk combines with the tannin of the tea and forms a curd which sinks to the bottom of the teapot. In pouring out the tea, care must be taken to avoid disturbing the leaves or the sediment. It may be poured directly into the cup or into a second heated teapot.

Tea with Egg.—Break an egg into a breakfast cup and beat it with a fork, adding a little sugar if liked. Then pour in the hot tea gradually. Sometimes the egg-yolk only is used.

Albumen Water.—The white of 1 egg.

Half-pint of cold water.

A few drops of lemon juice if desired.

Put the white of egg on a plate and beat it gently with a knife, taking care that it does not become frothy. Alternatively, it can be cut with clean scissors. It is then gently stirred into the water and left to stand for 10 to 15 minutes, after which it is strained through muslin, flavoured with lemon juice and sugar, or seasoned with salt and pepper.

Albuminized Lemonade.—Home-made lemonade is used instead of water, the method being the same as for albumen water.

Barley Water (*thick*).—1 tablespoon of pearl barley.

Half-pint of water.

Blanch the barley and then simmer it in half-pint of water for 1 hour, adding more water to make up the quantity as evaporation takes place. Strain and serve with sugar or salt, as preferred.

Prepared barley flour may be used, and this does not require blanching as does pearl barley.

Rice water and *Oatmeal water* are prepared in the same way. Tapioca or sago may be used instead of rice, and equal parts of milk and water may be substituted for the plain water.

Cornflour or Arrowroot.—1 teaspoon of cornflour or arrowroot.

1 teaspoon of sugar.

Half-pint of milk, or milk and water.

Blend the cereal to a smooth paste with a little cold milk or water and bring the rest to the boil. Pour it over the paste, stirring all the time, and then return it to the pan and boil for 3 minutes in order to burst the starch granules. Add the sugar and serve. A little butter or cream may be added to increase the food value, or 1 ounce of red wine will render the drink more stimulative. Nutmeg or cinnamon can be used instead of sugar, if desired.

Benger's Food.—1 tablespoon of Benger's food.

4 tablespoons of cold milk, or milk and water.

Half-pint of hot milk, or milk and water.

Benger's food contains some trypsin and some amylase—both of which are enzymes of the pancreatic juice—and therefore it is important that the feed should be prepared in such a way that the enzymes are allowed to act. The Benger's food is first mixed with the cold milk to a smooth paste. The half-pint of milk is heated to just below

boiling point and is then added slowly to the paste whilst gently stirring it. The mixture is set aside in a warm place for 15 to 20 minutes whilst the digestive processes take place, and the longer it is left the sweeter it becomes. It is then returned to the saucepan and is quickly brought to boiling point, stirring all the time. It is usually sweet enough for the patient's taste, so there is no need to add sugar.

Citrated Milk.—The effect of sodium citrate upon the caseinogen of cow's milk is to cause it to form a lighter and more digestible curd with the rennin of the gastric juice than it would otherwise do; so that citrated milk is often given to babies and to gastric cases. The amount used is usually from 1 to 2 grains of sodium citrate to each ounce of milk; but more than 3 grains per ounce is never necessary. The sodium citrate is simply mixed with the milk, stirring it well.

Humanized Milk.—1½ oz. of milk.

1½ oz. of water.

1 teaspoon of cream.

1 teaspoon of lactose.

Seeing that cow's milk contains twice as much protein as human milk, about the same amount of fat but less sugar, it is not altogether suitable for infant feeding unless it is humanized. This is done by diluting it with equal parts of water in order to reduce the protein, but this halves the fat and still further reduces the already deficient sugar; so that if the above ingredients are mixed the composition of the milk is practically the same as human milk.

Peptonized Milk. The process of peptonization can best be carried out by using Fairchild's peptogenic milk-powder, which is often put up in small tubes each containing sufficient to peptonize one pint of milk. It also contains some milk sugar. The powder is dissolved in water and is then added to the milk, which has been heated to a temperature of 100° F. After being well mixed the container, which may be a jug or a bottle, is placed in a pan of hot water the level of which must be above that of the milk, so that the temperature of the milk can be maintained at blood heat for a period of 5 to 20 minutes, according to the degree of digestion that is desired. The time should be limited as much as possible, for the peptonizing process causes a bitter taste to develop which renders the milk unpalatable. At the end of the time the milk is poured into a lined saucepan and is rapidly brought to boiling point in order to destroy the enzymes, and it is then quickly cooled, on ice if possible.

Pancreatized Milk. Benger's liquor pancreaticus is used. This contains pancreatic enzymes. The same method is followed as for peptonizing milk, except that 15 grains of sodium bicarbonate is added to the milk directly it is heated in order to provide the alkaline reaction necessary for pancreatic action. Pancreatized milk is sweeter and more palatable than peptonized milk.

Fortified Milk Mixture.—2 pints of liquid milk.

2 oz. of Ostermilk, or other dried milk.

2 oz. of lactose or glucose.

1 egg—fresh or dried.

1 small teaspoonful of salt.

This mixture gives 142 grammes of carbohydrate, 60 grammes of protein, and 69 grammes of fat. It supplies 1,470 Calories. If additional food value is required 2 eggs may be used.

The dried milk, lactose, and salt are mixed with a little cold water. The remainder of the milk is boiled and added slowly, stirring all the time. When cool, the beaten-up fresh egg is added. If reconstituted dried egg is used it is mixed with some of the milk and cooked for a little while in a double saucepan before being added to the mixture. The mixture is used for feeds as required. It may be flavoured with coffee, Marmite, cocoa, Ovaltine, cinnamon, or any other suitable substance that is acceptable to the patient. If ascorbic acid has been prescribed it should be crushed and added to each feed just before it is given.

Whey.—1 pint of fresh milk.

1 teaspoon of rennet.

Warm the milk to a temperature of 100° F., stir in the rennet, and let it stand in a warm place for 15 minutes, until the curd is formed. Then break it up with a fork and strain it through muslin. The whey can be seasoned, sweetened, or flavoured with fruit juice before serving.

Sherry whey is made by substituting 4 ounces of sherry for the teaspoonful of rennet. For *lemon whey* a dessertspoonful of lemon juice is used.

Cream whey is made according to the above recipe but, after straining, one-half to 1 ounce of cream is added.

Reinforced Protein Milk.—The curd from one pint of junket is added to another pint of milk, after having been rubbed through a fine hair sieve.

Suet and Milk.—1 pint of new milk.

½ to 1 oz. of mutton suet.

Shred the suet very finely and tie it loosely in muslin. Put the milk and the suet into a lined saucepan and simmer slowly for 15 to 20 minutes. Then strain and serve hot with a piece of dry toast or a biscuit. The milk may be flavoured with cinnamon or nutmeg if desired.

Thickened Milk.—Half-pint of milk.

½ oz. of flour.

Sugar or salt to taste.

Mix the flour with 1 teaspoonful of milk. Stir in the remainder and boil for 10 minutes. Add sugar or salt and serve hot. Wine may be added if required.

Rum and Milk.—Half-pint of milk.

2 oz. of rum.

A pinch of nutmeg.

Sugar to taste.

Heat the milk, sweeten to taste, and pour into a glass. Then add the rum and the nutmeg and serve the drink very hot.

Egg-flip.—1 egg.

Quarter of a pint of milk.

1 teaspoon of sugar.

2 or 3 drops of vanilla essence.

Separate the white from the yolk of the egg. Add the sugar and vanilla essence to the yolk and mix well. Then add the milk, which can be hot or cold as desired. Beat the white to a stiff froth and add two-thirds of it to the yolk and milk mixture, which is then poured into a tumbler and the remainder of the white is piled on the top.

Fruit-flip. This is made in the same way as egg-flip, but using quarter-pint of grapefruit, orange, or other fruit juice in place of the milk.

Savoury-flip. This is also made in the same way as an egg-flip, but instead of the sugar and vanilla flavouring a little Bovril or Marmite is mixed with the milk. Add pepper and salt to taste.

A tablespoonful of brandy, sherry, or wine may be added to a flip if allowed and desired.

Grapefruit Cooler.—1 egg.

1 grapefruit.

1 teaspoon of sugar, or 1 tablespoon of glucose.

Soda water and ice.

Beat up the egg with the sugar, add the grapefruit juice and strain the mixture into a tumbler. Fill up the tumbler with soda water and ice.

Eggnog.—White of one egg.

1 tablespoon of cream.

1 tablespoon of brandy or whisky.

Sugar to taste.

Beat the white of egg and put it in a tumbler, add the cream, brandy, and sugar and mix well.

Treacle-nog.—1 egg.

1 tablespoon of black treacle.

Quarter of a pint of milk.

Beat the egg and add the milk and then the treacle. Stir until all the treacle has melted and strain before serving. If the nog is desired hot the treacle should be mixed with hot milk and then be added to the egg.

Chocolate Eggnog. Make a cup of chocolate. Whisk the egg well and strain the hot chocolate over it. Whisk the mixture until it is frothy, and serve.

PREPARATION OF BROTHS AND SOUPS

Broths are unstrained soups made from fresh meat to which vegetables and cereals may have been added.

Soups are made from a foundation of *stock*, which is milk or water in which meat, bones, fish, or vegetables have been cooked. The meat yields soluble juices and extractives that give colour and flavour. The bones and connective tissues yield minerals and gelatin. When cold, stock should form a firm jelly. Meat stock may be white or brown. In the making of the former, chicken or veal is used and they may be seasoned with onions, celery, artichokes, or any other vegetables that will not give colour to the stock. For brown stock, beef, bones, and the coloured as well as the white vegetables may be used, and the meat should be sautéed before being put into the stock pot. If possible, stock should be made the day before the soup is required. A strong pan with a well-fitting lid should be used.

One pound of meat or bones is required for each quart of water. The meat should be wiped with a damp cloth and, after removing the fat, should be cut into small pieces and sautéed unless white stock is

to be made. Bones should be chopped. The meat needs 5 hours' cooking and the bones 9 hours. Vegetables should not be cut too small or they will break; they should be cooked for 3 hours. So that the bones need to be put in first, the meat 4 hours later, and the vegetables 2 hours after that if all are to be used. Fish is cut up and cooked for 1 hour.

When cooking is complete, the stock is strained off into a pan and is allowed to cool, when the fat can easily be removed from the top.

Soups may vary from thin liquids that contain little or no nourishment to thick varieties of considerable food value, depending upon the additions that have been made to the stock. Thick soups are made by adding flour or egg, and their food value may be still further increased by adding sieved vegetables.

Mutton Broth.—1 lb. of lean neck of mutton.

Half a carrot, turnip, and onion.

1 teaspoon of sago or flour or 1 dessertspoon of rice or pearl barley.

1 quart of cold water.

Seasoning.

Remove all fat from the meat, cut it into small pieces and place it in the pan with the water and salt. Bring it slowly to the boil. The vegetables are then cut into small dice, or they may be tied in a muslin bag. Add them to the boiling fluid and simmer gently for 2 to 3 hours. Then remove the meat and vegetables, either by lifting them out or straining the broth. Blanch the cereal or blend the flour and add it to the broth; bring it to the boil whilst stirring. Cut the meat from the bones and chop it finely, then add it to the broth and cook until the cereal is soft or the flour is thickened; which usually takes from 5 to 20 minutes. Skim off any fat and pour the broth into a hot tureen.

Chicken and veal broth are made in the same way, adding a little chopped parsley a few minutes before cooking is completed.

A richer broth may be made by pouring it slowly over a beaten-up yolk of egg just before the broth is served, stirring it whilst pouring.

Vegetable Soup.—3 oz. of mixed vegetables—carrot, onion, turnip, parsnip, peas, beans, etc.

Half-pint of stock or milk and water.

1 tablespoon of cream.

Seasoning.

Prepare the vegetables and cook in the stock until tender. Then rub them through a sieve, return to the pan, and add the seasoning. Bring it slowly to the boil. Put the cream into a soup cup and stand it in a warm oven for a few minutes and then pour the soup over it, stirring well.

Artichoke Soup.—½ lb. of Jerusalem artichokes.
1 stick of celery.
½ oz. of butter.
1 pint of light stock or broth.
1 bay leaf.
A few parsley stalks.
2 oz. of milk.
Yolk of 1 egg.
White pepper and salt.

As the artichokes are peeled put them into cold water containing a few drops of vinegar in order to preserve the colour. Then slice the artichokes and cut the celery into small pieces. Melt the butter in a lined pan, add the prepared vegetables with the seasoning, bay leaf, and parsley stalks, and cook for 10 minutes with the lid on the pan, shaking the pan frequently to prevent the contents burning. Then add the stock and allow all to simmer gently for 1 hour, or until the artichokes are quite soft. Strain through a hair sieve into a basin, pressing as much as possible; then, after having rinsed out the saucepan, return the soup to it and reheat. Beat the yolk of egg and milk together and add to the soup, stirring it well over the heat until *almost* boiling. This soup should be white in colour; but it may be greenish if the artichokes were not carefully prepared.

Onion Soup.—1 large or 2 small Spanish onions.
1 pint of stock or broth.
Half-cup of milk.
1 tablespoon of cream.
½ oz. of butter.
1 teaspoon of cornflour.
Seasoning.

The onions are peeled and soaked in boiling water with a little salt for 30 minutes and are then cut into slices and put into a lined saucepan with the butter and the stock, and are cooked slowly until tender. Then as much as possible is rubbed through a fine sieve and returned to the saucepan. The cornflour is mixed smoothly with the

milk and added to the soup and the whole is stirred over the heat until it is boiling. Then the seasoning is added and, after cooking slowly for 5 minutes, the cream is added and is well stirred in just before serving.

Tomato Soup.—½ lb. of tomatoes, 1 cup of tinned tomatoes.
1 pint of white stock or milk.
1 small carrot and 1 small onion.
1 oz. of butter.
1 dessertspoon of flour.
A little water.

Peel the onion and scrape the carrot, cut both into small pieces, and cook in the butter until tender. Then add the tomatoes, the stock, and the seasoning and simmer for 2 hours. Pass it through a hair sieve, rubbing through as much of the vegetables as possible. Mix the flour to a smooth paste with the water and add it to the soup, which is returned to the saucepan, brought to the boil, and cooked for 5 minutes.

Potato Soup.—¼ lb. of cooked potatoes.
1 slice of onion.
Half-pint of milk or white stock.
Seasoning.

Rub the potatoes through a hair sieve and beat until they are white and creamy. Simmer the onion in the seasoned milk or stock until it is tender. Then strain the stock, add the potato whilst whipping with a fork or a whisk, return to the saucepan and heat before serving.

Fish Soup.—1 lb. of white fish.
1 pint of cold water.
5 oz. of milk.
1 small onion.
A little chopped parsley.
½ oz. of flour.
Salt and pepper to taste.

Cut the fish into small pieces and simmer gently with the blanched onion and the seasoning, removing any scum as it rises. Lift out a few neat pieces of fish, remove skin and bone, and keep them hot for serving with the soup. Allow the remainder to cook slowly for about an hour, or until all the food value is removed from the fish; and then strain through a fine sieve. Clean the saucepan and put in the butter and when this is melted stir in the flour until it is smooth,

add the fish liquor and the milk and stir until it boils. Then add the pieces of fish that were reserved and also the chopped parsley, simmer for 2 minutes longer and serve very hot.

Fish Soup with Oysters.—Half-pint of fish soup—made as above.

Half-dozen fresh oysters and their liquor.

Yolk of 1 egg and 2 oz. of cream.

Put the oysters in a small saucepan with their liquor and heat until nearly boiling. Then strain them and remove the hard gristle from each oyster and also the beard—or fringe which encircles the oyster. Heat the fish soup to boiling point together with the oyster liquor and then put in the oysters and the cream just before serving. The soup must not be allowed to boil after the oysters are put in or they will become hardened and indigestible. The beaten egg-yolk is put into the tureen and the hot soup is poured over it, stirring all the time.

PREPARATION OF EGG DISHES

Boiled Egg.—The egg may either be put into boiling water and boiled for 3½ minutes, or into cold water, brought to the boil and boiled for 1 minute. Very fresh eggs need 1 minute longer in each case. Hard-boiled eggs need double these times, and should be taken from the saucepan and dropped straight into cold water to prevent the formation of a dark ring at the junction of the yolk and the white.

Coddled Egg.—The egg is put into boiling water and left for 10 minutes away from the heat. With this method of cooking the egg is said to be more easily digested than when boiled in the usual manner.

Scrambled Egg.—1 egg, or 1 tablespoon of dried egg.

1 tablespoon of milk.

Small piece of butter.

Pepper and salt.

The egg and milk are beaten together and seasoned. The fat is melted in a small saucepan and the egg and milk mixture is poured in and is cooked very gently until just set, stirring all the time. Care must be taken that the heat is not too great, or the cooking too prolonged, or the egg protein will be hardened and the result lumpy and watery. It is served on hot buttered toast. If dried egg is used the tablespoon of powder must be made into a smooth paste with 2 tablespoons of water. It is then mixed with milk and cooked as

before. Chopped parsley, mixed herbs, ham, or tomato may be added, or grated cheese may be mixed with the milk and egg.

Poached Egg.—The egg is broken on to a saucer and carefully slipped into a shallow pan of salted water, to which a little lemon juice or vinegar may be added. The water should be just below boiling point, for bubbling water spoils the shape of the egg. It is cooked until just set, taking about 5 minutes. It is then drained and served on hot buttered toast.

Baked Egg.—A saucer or small dish is buttered and sprinkled with breadcrumbs and seasoning. The egg is carefully dropped into the middle and is covered with breadcrumbs, or grated cheese. It is cooked in the oven until set.

Egg Nest.—The white of the egg is carefully separated from the yolk and is beaten to a stiff froth, adding a little salt, and white pepper if liked. It is then piled on to a slice of hot buttered toast, leaving or making a hole in the middle into which the yolk is carefully slipped. A little butter is put on top of the yolk and the whole is baked for 3 to 5 minutes. It is then garnished with parsley before serving.

Snow Eggs.—Half-pint of milk.

2 eggs.

1 dessertspoon of sugar.

Lemon rind or cinnamon stick for flavouring.

Pinch of salt.

Put the milk and flavouring in a shallow saucepan and bring slowly to the boil. Beat the whites of the eggs to a stiff froth, drop them in spoonfuls into the hot milk and poach them slowly for a few minutes; and when firm lift them on to a glass dish. Then mix the yolks with the sugar and the pinch of salt, add the milk, put into the pan and stir over the heat until the mixture thickens, taking care not to allow it to boil. Strain this custard round the snow eggs, and garnish with cherries or angelica.

Savoury Omelet.—2 eggs.

1 teaspoon of chopped parsley.

$\frac{1}{2}$ oz. of butter.

Seasoning.

Beat the eggs, adding the parsley and seasoning. Melt the butter in a round frying pan. Pour in the beaten eggs and cook gently, stirring lightly with a broad knife until the butter is incorporated and the mixture begins to set; then allow it to cook slowly until it is

brown underneath, as can be seen if the edge is lifted slightly with the knife. Then hold the pan in front of the fire, or under the grill, until the top is a golden brown. The omelet is then folded over with a knife or fish slice, turned on to a hot dish, garnished, and served at once.

Variations can be made by adding flaked cooked fish, minced chicken, ham, or tongue to the mixture, or these may be heated in a cream sauce and be placed on one half of the cooked omelet before it is folded over.

For *cheese omelet*, finely grated cheese is added before cooking.

Sweet omelets are prepared in the same way, using sugar instead of pepper and salt, and jam or fruit is folded into them.

PREPARATION OF SIMPLE SWEET DISHES

Egg Custard.—1 egg, or 2 yolks.

Quarter to half a pint of milk.

1 teaspoon of sugar.

Flavouring, e.g. 3 drops of vanilla essence, grated orange rind, nutmeg, or cinnamon.

¼ oz. of butter.

Beat the egg with the sugar and flavouring, add the milk and pour the whole into a greased pie dish or cup and put the butter on the top. If for a baked custard the pie dish is put into a pan of cold water and is baked in a moderate oven until set. The pan of water prevents too rapid cooking which would result in the custard becoming watery.

For a steamed custard the top of the cup is covered with greased paper and it is put in a pan with about 1 inch of boiling water, the lid is put on the pan, and the custard is steamed for 10 to 15 minutes, when it should be set.

Plain Soufflé.—2 eggs.

½ oz. of butter.

2½ oz. of milk.

½ oz. of flour.

Teaspoon of sugar.

A little grated lemon rind.

A few drops of lemon juice.

Melt the butter in a small lined saucepan and add the flour, mixing it in smoothly with a wooden spoon. Then pour on the milk and stir it over the heat until the mixture thickens. This is called a *panada*, and

it is important that it should be thoroughly cooked or it will not bind the soufflé together satisfactorily. When ready it should draw away from the sides of the pan quite cleanly. Then remove the pan, add the sugar, grated lemon rind and juice, and the egg-yolks one at a time, beating each one well into the mixture. Next, beat the whites to a stiff froth and stir them in lightly just before pouring the mixture into a pan that has been well greased with butter; but the pan should not be more than half-filled. Cover the pan with greased paper and steam very gently, as for a steamed custard, for about 20 minutes. The soufflé should then be firm to the touch and it should have risen well. Let it stand for a few minutes before turning it out, after which it is sprinkled with castor sugar and is served immediately.

Different flavours can be substituted for the lemon, or a coffee soufflé can be made by using equal parts of black coffee and milk, instead of plain milk.

Milk Jelly.—Half-gill (2½ ozs) of milk.
1 teaspoon of sugar.
2 tablespoons of water.
3 drops of vanilla essence.
¼ oz. of gelatine.

Put the gelatine, water, and sugar in a pan and heat until the gelatine is dissolved. Heat the milk and add the dissolved gelatine and vanilla essence. Pour it into a wet mould and allow it to set. Then turn it out.

Egg Jelly.—1 egg.
¼ oz. of gelatine.
Juice of 1 orange, 1 lemon, or half a grapefruit.
1 teaspoon of sugar.
2 tablespoons of water.

Put the gelatine, sugar, water, and thinly pared fruit rind into a pan and heat for about 5 minutes. Beat the egg and add the fruit juice to it and then the dissolved gelatine. Strain and pour into a wet mould. Turn it out when set.

Orange Mould.—½ oz. of cornflour or arrowroot.
3 oz. of orange juice.
1 teaspoon of sugar.
Rind of half a lemon.
5 oz. of water.

Boil the water and the pared lemon rind until reduced to half the

original quantity. Blend the cornflour, or arrowroot, with the strained orange juice and strain the boiling water over it. Return the whole to the pan and boil for 3 minutes, stirring all the time. Add the sugar, pour it into a wet mould and allow it to set.

This sweet is very suitable for a fat-free diet.

Fresh Fruit Salad.—Black fruits—such as grapes, prunes, and blackcurrants.

Brown fruits—such as dates and raisins.

Red fruits—such as cherries, currants, raspberries, and strawberries.

White fruits—such as pears, apples, and bananas.

Green fruits—such as greengages and grapes.

Yellow fruits—such as oranges, peaches, and apricots.

1 tablespoon of sugar.

Half a lemon.

2 to 3 oz. of water.

Boil the sugar and water together and add the lemon juice. Prepare the fruits and put them into a glass dish, pour over the hot syrup and stand aside until cold, when it is ready to serve. If sugar is not allowed in the diet, the juice of an orange can be squeezed over the salad.

Spanish Cream.—¼ oz. of gelatine.

2 tablespoons of water.

4 oz. of hot milk.

1 egg.

2 tablespoons of sugar.

Vanilla essence.

Pinch of salt.

Soak the gelatine in the cold water. Beat the egg-yolk, add the sugar and the salt and then slowly add the hot milk, stirring all the time. Cook it in a pan of hot water until it thickens, then add the gelatine and allow the mixture to cool. When it has begun to jelly fold in the stiffly beaten white of egg and pour into a wet mould. When set turn it out and serve with whipped cream or crushed fruit.

Orange Water Ice.—5 oz. of water.

2 oz. of sugar.

5 oz. of orange juice.

1½ tablespoons of lemon juice.

Half a teaspoon of grated orange rind.

Boil the water and sugar for 5 minutes, cool and add fruit juice

and grated rind. Strain and place in a freezer, stir about every 15 minutes until it is of firm consistency. If frozen too quickly, or over-frozen, it has particles or chips of ice in it.

Banana Fool.—2 eggs.

Half-pint of milk.

1 oz. of white sugar.

1 oz. of castor sugar.

5 bananas.

Few drops of lemon juice.

Vanilla flavouring.

Prepare a boiled custard by beating the yolks of the eggs with a little of the cold milk, heat the remainder of the milk and pour it over the yolks, stirring well, and add the white sugar. Then pour it into a basin and stand it in a saucepan of hot water. Place over heat and stir slowly until the custard thickens; but do not allow it to boil or it will curdle. Then add the vanilla flavouring. Peel the bananas and mash them with a fork, adding the lemon juice and half an ounce of castor sugar. Mix the boiled custard with this and leave it until quite cold. Whisk the whites of the eggs to a stiff froth, adding the rest of the castor sugar. Fold half of this lightly into the banana mixture, put into custard glasses and pile the rest of the whisked whites on the top. Decorate with cherries, angelica, or chopped nuts.

Apples, pears, gooseberries, raspberries, strawberries, or rhubarb may be substituted for the bananas if they are first stewed and rubbed through a sieve.

APPENDIX

Food Materials	Amount	Calories	Protein gm.	Fat gm.	Carbo g
Meats:					
Cooked meats, including poultry:					
Lean	75 gm. = 2½ oz.	115–130	20–24	4–6	—
Moderately fat	75 gm. = 2½ oz.	175–200	16–21	12–18	—
Very fat	75 gm. = 2½ oz.	250–320	10–12	30–32	—
Liver—					
Beef	75 gm. = 2½ oz.	100–110	15·5	2·5	4·
Calf	75 gm. = 2½ oz.	100–110	15	3–3·5	2·75–
Corned beef	100 gm. = 3½ oz.	270–276	26·3	18·7	—
Boiled ham	75 mg. = 2½ oz.	180–190	14–15	13·5–14·5	—
Kidneys	75 gm. = 2½ oz.	82–86	12–12·5	3·5–4	—
Tongue, ox	75 gm. = 2½ oz.	130–140	10·5–11	11–12	—
Sweetbread	60 gm. = 2 oz.	108–112	15–15·4	5–5·5	—
Bacon	30 gm. = 1 oz.	160–170	6–7	14·5–15	—
Fish:					
White fish—					
Steamed	75 gm. = 2½ oz.	70–75	14–15	1·25–1·75	—
Fried	75 gm. = 2½ oz.	115–125	14	4–5	—
Fat fish—					
Steamed or grilled	75 gm. = 2½ oz.	120–130	13–13·5	7·5–8	—
Fried	75 gm. = 2½ oz.	125–135	12–12·5	8–9	—
Canned salmon	75 gm. = 2½ oz.	120–125	15·5–16	6·5–7	—
Canned crab or lobster	75 gm. = 2½ oz.	60–65	14–14·5	1	—
Shrimps, canned or boiled	60 gm. = 2 oz.	48–50	10–11	0·5	0·
Oysters, raw	half a dozen	60–65	7–8	1·5–1·7	4–4
Sardines, canned in oil	30 gm. = 1 oz.	56–60	7–7·5	3–3·2	—
Dairy Products:					
Milk—					
Whole	100 gm. = 3·5 oz.	65	3·75	3–3·5	4
Skimmed	100 gm. = 3·5 oz.	36	3·5	0·2	5
Whole, unsweetened condensed	100 gm. = 3·5 oz.	327	8·1	8·4	54·
Cream—					
Light	100 gm. = 3·5 oz.	208	2·9	20	4
Heavy	100 gm. = 3·5 oz.	337	2·3	35	3·
Butter	100 gm. = 3·5 oz.	733	0·6	81	0·
Cheese—					
Cheddar	100 gm. = 3·5 oz.	410	24·5	34	—
Swiss	100 gm. = 3·5 oz.	404	28·6	31·3	1·
Camembert	100 gm. = 3·5 oz.	306	19·7	25·2	—
Eggs—					
Whole, fresh	50 gm. or 1 egg	80	6·4	5·8	0·
Dried	28 gm. or 1 oz.	163	13·0	11·9	0·

Minerals			Vitamins				
			International Units				Sherman Units
Calcium mg.	Phosphorus mg.	Iron mg.	A	B_1 Aneurin	C Ascorbic A.	D Calciferol	Nicotinic A
10–14	200–250	3–4	15–30	10–14	—	—	75–90
9–12	175–200	2·5–3·5	20–30	5–10	—	4–6	30–40
6–8	120–150	1·5–1·75	30–40	—	—	6–10	18–20
9	270–300	6–7	3,500–7,000	78	500	45	600–620
9	270–300	3–5	3,500–7,000	75–100	500	15	550–600
15	280–285	3–3·8	—	—	—	—	—
8	140–145	1–1·2	—	50	—	—	50
7-7·5	130–135	3	600–650	60	95–105	—	550–600
6	118–120	1·5	+	+	—	—	+
8	350–360	1	+	+	—	—	+
4	60–64	0·8–1	4	10	—	—	1
35	150–165	0·5	7	18	—	—	+
35	150–165	0·5	—	18	—	—	+
40–50	150–160	0·5–1	40–50	15–35	—	+	15–30
40–50	150–160	0·5–1	Greatly lessened	15–35	—	+	15–30
Depends upon whether bones are	eaten or not	0·2	28–300	20–30	—	200–400	40–60
15	150	0·3	—	—	—	—	—
0·4	0·7	0·7	+	40–45	—	—	15–40
55–60	140–150	5–6	150	130	60	5–6	++
100–120 the bones being eaten	200–205	0·5	++	7	75–80	++	+
118	93	0–0·1	100–250	15–25	0–50	2–10	40–60
122	96	0·1	10	15		—	80
300	235	0·5	+	25	0 to +	—	+
97	87	0·15	700	5	—	10	+
86	67	0·15	1,400	a trace	—	14	+
16	17	0·15	1,000–2,000	—	—	40–100	—
930	700	1·2	2,000	25	—	—	200
1,086	812	1·2	+	+	—	—	+
680	497	0·8	+	+	—	—	+
31	112	1·5	500–1,500	25–50	—	30–120	120–140
62	220	3·1	850	114	—	70	—

NUTRITIVE VALUES OF AVERAGE SERVINGS OF COMMON FO

Food Materials	*Amount*	*Calories*	*Protein gm.*	*Fat gm.*	*Carbo g*
Vegetables:					
Potatoes—					
Raw	100 gm. = 3½ oz.	90–95	2·5	—	2
Boiled	100 gm. = 3½ oz.	90–95	2·5	—	2
Baked	100 gm. = 3½ oz.	100–120	3	—	25–
Fried chips	100 gm. = 3½ oz.	500–550	6–6·5	37–38	45–
Cabbage	100 gm. = 3½ oz.	18–30	1·5	—	4–
Cauliflower	100 gm. = 3½ oz.	30–32	2·5	—	4·5
Broccoli	100 gm. = 3½ oz.	36–38	3–3·5	—	5·5
Brussels sprouts	100 gm. = 3½ oz.	55–60	4–4·5	0·5	8–
Artichokes, French	200 gm. = 7 oz.	126	5·8	0·8	23·
Beans—					
Broad	100 gm. = 3·5 oz.	101	8·1	0·6	15·
Runner	100 gm. = 3·5 oz.	42	2·4	0·2	7·
Beetroot	100 gm. = 3·5 oz.	46	1·6	0·1	9·
Carrots, raw	100 gm. = 3·5 oz.	45	1·2	0·3	9·
Celery, raw	50 gm. = 1·8 oz.	11	0·6	0·1	1·
Cucumber, raw	50 gm. = 1·8 oz.	7	0·3	0·05	1·
Lentils, dried	28 gm. = 1 oz.	98	7	0·3	16·
Lettuce, raw	57 gm. = 2 oz.	10	0·7	0·1	1·
Onions, raw	100 gm. = 3·5 oz.	49	1·4	0·2	10·
Parsnips	100 gm. = 3·5 oz.	83	1·5	0·5	18·
Peas—					
Green	50 gm. = 1·8 oz.	50	3·3	0·2	8·
Tinned	100 gm. = 3·5 oz.	67	4·5	0·3	11·
Radishes	28 gm. = 1 oz.	6	0·3	0·03	1·
Spinach	100 gm. = 3·5 oz.	25	2·3	0·3	3·
Tomatoes, raw	100 gm. = 3·5 oz.	23	1	0·3	4
Turnips	100 gm. = 3·5 oz.	35	1·1	0·2	7·

Minerals			*Vitamins*				
			International Units				*Sherman Units*
Calcium mg.	*Phosphorus mg.*	*Iron mg.*	*A*	*B_1 Aneurin*	*C Ascorbic Acid*	*D Calciferol*	*Nicotinic A.*
12	53	1	30	30–60	150–250	—	24
10	40	0·5–1	—	25	60–80	—	22
20	50	0·5–1	—	25	—	—	20
Varies with	degree of dr	ying	—	—	—	—	—
40	30	0·3–0·5	Varies with	method	of cooking,	but if raw:	
			0–75	25–40	1,000–1,500	—	30–60
120	60	1	35	50	1,000 if raw	—	40–60
			8,000–9,000		1,500 when	—	140
140	68	1·4	when	30	raw		
			eaten raw				
26	120	1·2	400	50	1,200 when raw	—	120
80	188	1·9	430	80	350	—	—
—	—	—	—	++	—	—	++
55	50	1·16	1,000 raw 700 cooked	25 raw 17 cooked	200 raw 60 cooked	—	25 raw 25 cooked
28	42	0·85	—	17	125 raw	—	25
45	41	0·62	3,000	45	75	—	40
39	23	0·31	green 750 bleached 0	5	50	—	+
5	10	0·17	10	10	75	—	+
29	109	2·4	25	35	—	—	28
bleached 35	23	0·25	57	11	46	—	14
green 39	16	0·57	1,710	17			28
41	47	0·48	—	20	150	—	8
60	76	0·77	0 –+	35	200 raw	—	—
					0–60 cooked		
			375 raw		225 raw	—	37
11	63	1·04	200 cooked	50	0–70 cooked	—	+
16	84	1·3	+	30	—		
				6	140		
9	9	0·25	a trace	40	800 raw	—	+
			22,500 raw		0–200 cooked		125
78	46	2·5	15,000 cooked	25	450	—	
						—	25
11	29	0·44	700				
56	47	0·52	15	20	500 raw		
					0–150 cooked	—	20

NUTRITIVE VALUES OF AVERAGE SERVINGS OF COMMON FO

Food Materials	Amount	Calories	Protein gm.	Fat gm.	Carbo g
Fruits:					
Apple—					
Baked	165 gm. = 5·8 oz.	200	0·8	0·8	47
Raw	128 gm. = 4·5 oz.	81	0·4	0·5	18
Banana	100 gm. = 3·5 oz.	99	1·2	0·2	23
Blackberries	100 gm. = 3·5 oz.	62	1·2	1·1	11
Cherries	100 gm. = 3·5 oz.	80	1·1	0·5	17
Dates, dried	50 gm. = 1·8 oz.	158	1·1	0·3	37
Figs, dried	50 gm. = 1·8 oz.	150	2	0·6	34
Grapefruit—					
Fresh	100 gm. = 3·5 oz.	44	0·5	0·2	10
Tinned in syrup	100 gm. = 3·5 oz.	58	0·5	0·2	13
Grapes	100 gm. = 3·5 oz.	74	0·8	0·4	16
Lemons	100 gm. = 3·5 oz.	44	0·9	0·6	8
Loganberries—					
Fresh	100 gm. = 3·5 oz.	69	1	0·6	15
Tinned	100 gm. = 3·5 oz.	55	1	0·1	12
Water melon	330 gm. = 11·7oz.	103	1·7	0·7	22
Oranges	155 gm. = 5·5 oz.	78	1·4	0·3	17
Peaches—Fresh	100 gm. = 3·5 oz.	51	0·5	0·1	12
Tinned in syrup	100 gm. = 3·5 oz.	75	0·4	0·1	18
Pears—Fresh	100 gm. = 3·5 oz.	70	0·7	0·4	15
Tinned in syrup	100 gm. = 3·5 oz.	75	0·2	0·1	18
Pineapple—Fresh	90 gm. = 3 oz.	52	0·3	0·1	12
Tinned in syrup	(2 slices and 3 teaspoons juice) 104 gm. = 3·7 oz.	90	0·4	0·1	22
Plums, raw	100 gm. = 3·5 oz.	56	0·7	0·2	11
Prunes, dried but cooked	100 gm. = 3·5 oz.	139	0·6	—	34
Raisins, dried	28 gm. = 1 oz.	83	0·6	0·1	19
Raspberries, raw	100 gm. = 3·5 oz.	67	1·1	0·6	14
Rhubarb	100 gm. = 3·5 oz.	18	0·5	0·1	3
Strawberries, raw	100 gm. = 3·5 oz.	41	0·8	0·6	8

NUTRITIVE VALUES OF AVERAGE SERVINGS OF COMMON FOODS

Minerals			*Vitamins*				
			International Units				*Sherman Units*
Calcium mg.	*Phosphorus mg.*	*Iron mg.*	*A*	B_1 *Aneurin*	*C Ascorbic Acid*	*D Calciferol*	*Nicotinic A.*
11	21	0·49	91	33	—	—	33
9	15	0·45	127	19	254	—	25
8	28	0·6	300	16	200		30
32	32	0·9	150	8	100	—	—
			20–600		60–340	—	
19	30	0·4	according to	16	according to	—	—
			variety		variety		
35	28	1·78	63	13	—	—	+
80	58	1·44	33	20	—	—	22
21	20	0·3	8	20	750	—	+
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
22	11	0·6	0 to +	20	850	—	+
34	22	1·4	+	+	400	—	—
34	22	1·4	—	—	—	—	—
23	43	0·76	230	45	330	—	40
37	28	0·62	352	39	1,325	—	16
			White 5	10		—	—
10	19	0·33	Yellow 1,000	15	150		
—	—	—	—	—	—	—	—
15	18	0·32	8	20	40	—	25
—	—	—	—	—	—	—	—
7	10	0·32	90	27	270	—	14
—	—	—	+	20	200	—	10
20	27	0·56	192	40	100	—	—
15	30	0·8	++	+	—	—	++
17	38	0·85	14	14	—	—	8
49	52	1	++	30	525	—	—
					360 raw		
44	18	0·56	—	—	0–250 cooked	—	—
34	28	0·68	25	15	1,200	—	—
						—	

Food Materials	*Amount*	*Calories*	*Protein gm.*	*Fat gm.*	*Carbohy gm*
Cereals and Cereal Products:					
White bread	100 gm. = 3·5 oz.	247	8·5	1·3	50·4
Wholemeal bread	100 gm. = 3·5 oz.	259	9	3	49
Barley, pearl	14 gm. = 0·5 oz.	52	1·2	0·2	11·3
Cornflour	100 gm. = 3·5 oz.	350	0·7	0·3	86
Macaroni, uncooked	28 gm. = 1 oz.	27	1·1	0·1	5·5
Oatmeal—Dry	100 gm. = 3·5 oz.	396	14·2	7·4	68·2
Cooked	100 gm. = 3·5 oz.	64	2·3	1·2	11
Rice, cooked	28 gm. = 1 oz.	98	2	0·08	22
Soya bean	100 gm. = 3·5 oz.	380	37·3	20·2	12
Tapioca	28 gm. = 1 oz.	100	0·2	0·06	24·7
Yeast—					
Dried brewers'	100 gm. = 3·5 oz.	348	46	1·6	37·4
Dried bakers'	100 gm. = 3·5 oz.	348	46	1·6	37·4
Moist bakers'	100 gm. = 3·5 oz.	109	13·3	0·4	13
Sugars and Sweets:					
Chocolate—					
Milk	100 gm. = 3·5 oz.	525	7·2	34·1	47·1
Plain	100 gm. = 3·5 oz.	522	4·6	32·5	52·8
Honey	100 gm. = 3·5 oz.	277	0·4	—	68·8
Jam	100 gm. = 3·5 oz.	249	0·2	—	62
Marmalade	100 gm. = 3·5 oz.	280	0·4	—	70
Sugar—					
Brown	100 gm. = 3·5 oz.	380	—	—	94·9
Granulated	5 gm. = 1 teaspoon	20	—	—	4·9
Lump	1—average size	20	—	—	4·9
Syrup, golden	100 gm. = 3·5 oz.	286	0·3	—	71
Treacle, black	100 gm. = 3·5 oz.	247	0·2	—	60·5
Food Concentrates:					
Black currant purée	100 gm. = 3·5 oz.	146	0·6	—	36
Black currant syrup	100 gm. = 3·5 oz.	184	—	—	46
Cod liver oil (Ministry of Food)	100 gm. = 3·5 oz.	900	—	100	—
Orange juice (Ministry of Food)	100 gm· = 3·5 oz.	200	—	—	50
Rose-hip syrup	100 gm. = 3·5 oz.	202	0·6	—	50

Minerals			*Vitamins*				
			International Units				*Sherman Units*
Calcium mg.	*Phosphorus mg.*	*Iron mg.*	*A*	*B_1 Aneurin*	*C Ascorbic Acid*	*D Calciferol*	*Nicotinic A.*
31	97	0·8	—	20	—	—	10
50	154	1·6	10	85	—	—	20
3	26	0·3	—	11	—	—	+
18	26	0·3	—	—	—	—	—
1	7	0·07	—	+	—	—	—
65	387	4·8	a trace	135	—	—	+
11	65	0·58	—	20	—	—	+
3·3	28	0·25	—	32	—	—	+
216	583	2·7	—	+++	—	—	+++
5	2	0·5	—	a trace	—	—	—
87	2,943	?	0–150	2,000	—	—	1,500
87	2,943	?	0–150	500	—	—	1,200
24	561	a trace	1,400–1,800	300–400	—	—	400–500
175	420	1·7	—	120	—	—	—
26	350	3·3	75	90	—	—	—
5	18	0·4	—	—	—	—	—
12	—	—	20	—	—	—	—
—	—	—	—	—	—	—	—
1	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—
26	—	1·4	—	—	—	—	—
490	30	9·2	—	—	—	—	—
			A I.U.	*B*	*C mg.*	*D I.U.*	—
30	—	2·0	—	—	65	—	—
20	—	2·0	—	—	55	—	—
—	—	—	100,000	—	—	8,500	—
—	—	—	—	—	160	—	—
—	—	—	—	—	150	—	—

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